ISSN:0974-6358

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VOL. 4 (1) INDEXED JOURNAL JAN. 2011

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Research Article

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Review

Research Article

A Computed Tomographic Study of Canal Variations in Maxillary & Mandibular first Premolar Teeth in Jaipur Population – An *in vitro* Study.

Deepak Sharma, Meetu Mathur

Department of Conservative Dentistry & Endodontics, Jaipur Dental College, Jaipur.

Abstract:

The present study was carried out to observe root canal variations in maxillary and mandibular first premolar teeth in the local population using spiral computed tomography. Sixty, each of well formed maxillary and mandibular first premolar teeth without any carious lesions were used in this study. They were placed in 5% sodium hypochlorite solution for 30 minutes for the removal of organic debris. They were then stored in normal saline till further experiment was carried out. Each tooth was scanned with a slice thickness of 0.625 mm. Data collected was used to reconstruct the scanned teeth three dimensionally. The configuration seen in longitudinal and transverse sections was used to classify the canal anatomy according to Vertucci's classification.

Key Words: First premolar, Mandibular, Maxillary, Vertucci's classification, Spiral computed tomography.

Introduction:

Anatomical complexities of the root canal system has been long established. A root with a graceful tapering canal and a single foramen is the exception rather than the rule. Any attempt to perform endodontic therapy must be preceded with a thorough understanding of the anatomy of both the pulp chamber and the root canal system (Krasner & Rankow, 2004).

Anatomical variability of the teeth is often a complicating factor in root canal treatment and many different methods have been used to investigate tooth morphology (Mikrogeorgis et al, 1999). These methods include decalcification of the teeth and dye injection (Vertucci, 1984). The various dyes used are India Ink (Gulabivala et al, 2001), hematoxylin dye etc. Radiographic studies *in vitro* (Gonzalez & Gonzalez, 2003), sectioning of teeth (Weine et al, 1999) have been used to study the anatomy of the pulp floor.

However, except the radiographic technique, all these are *in vitro* techniques and cannot be used clinically. Furthermore, they do not provide the ability to study the external and internal anatomy of teeth three-dimensionally (Mikrogeorgis et al, 1999).

Current literature shows that where atypical anatomy is suspected, in addition to the conventional radiograph, modern radiographic techniques like helical or spiral computed tomography are being used for a proper diagnosis.

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Tachibana & Matsumoto (1990) were the first to study the applicability of computerized tomography in endodontics.

Computed tomography scans cause no geometric distortions on magnification while determining the canal morphology of teeth (Vannier et al, 1997).

Spiral computed tomography (SCT) has gained popularity in the study of hard tissues (Chandra et al, 2009). The successful use of SCT in dentistry was reported by Robinson et al (2002). Sponchiado et al(2006) confirmed the variations in the root canal anatomy using SCT. The advantage of SCT is that it offers a non-invasive reproducible technique for 3-dimensional assessment of root canal system and aids the clinician to visualize the internal anatomy precisely.

Therefore, it was decided to study the variations in canal configurations of maxillary and mandibular first premolar teeth using spiral computed tomography.

Material and Methods:

Sixty each of non-carious maxillary & mandibular first premolars were collected and used for this study. The teeth were extracted in the Department of Oral and maxillo-facial Surgery, Jaipur Dental College & Hospital, Jaipur, due to trauma, periodontal disease or for orthodontic reasons. The teeth were collected without consideration of age, sex and religion. The extracted teeth were thoroughly washed and were cleaned to remove blood, saliva or any debris. They were then placed in 5% sodium hypochlorite solution for thirty minutes for the removal of organic debris

from the surface. Calculus, if present, was removed using ultrasonic scaler. The cleaned samples were then stored in normal saline till further experiment was carried out.

Preparation of specimens :

The specimens were randomly divided into fifteen batches of four teeth each for maxillary and mandibular teeth. The teeth of each batch were mounted on a platform made with the help of modelling wax (Fig. I). The teeth were subjected to high quality computed tomography (G.E. Light Speed Pro) scanner which acquires 40 slices per second (Fig. II). Each tooth was viewed in longitudinal as well as in transverse sections. The transverse sections were studied at the cervical, middle and apical third.

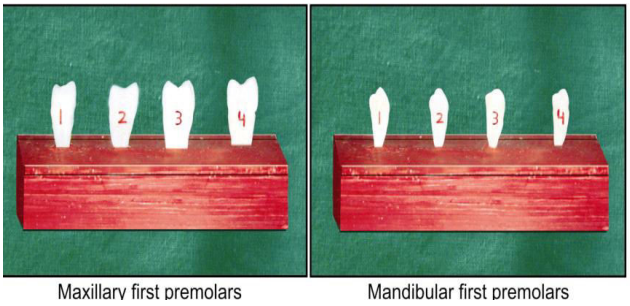


Fig. I: Mounted on a platform made with the help of modelling wax.

Fig. II: Teeth subjected to high quality computed Tomography (G.E. Light Speed Pro) Scanner.

Each tooth was scanned from crown to anatomical apex at a high resolution with a slice thickness of 0.625 mm. Data collected was then used to reconstruct the scanned teeth three dimensionally. This was done on a separate workstation using AW 4.2 GE (Reuben et al, 2008) software. The configuration seen in the longitudinal sections and transverse sections of the maxillary teeth (Fig. III) and mandibular teeth (Fig. IV) were used to classify the canal anatomy according to Vertucci's classification.

The results were statistically analyzed by Chi-square test using statistical package for social sciences (SPSS) software.

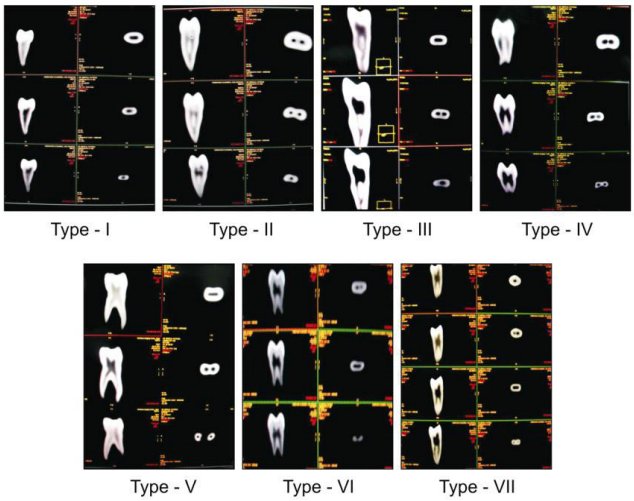


Fig. III: Showing the types of configurations seen in longitudinal and transverse sections in maxillary first premolar teeth according to Vertucci's classification.

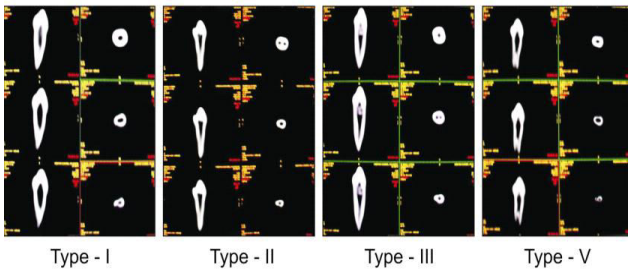


Fig. IV: Showing the types of configurations seen in longitudinal and transverse sections in mandibular first premolar teeth according to Vertucci's classification.

Results:

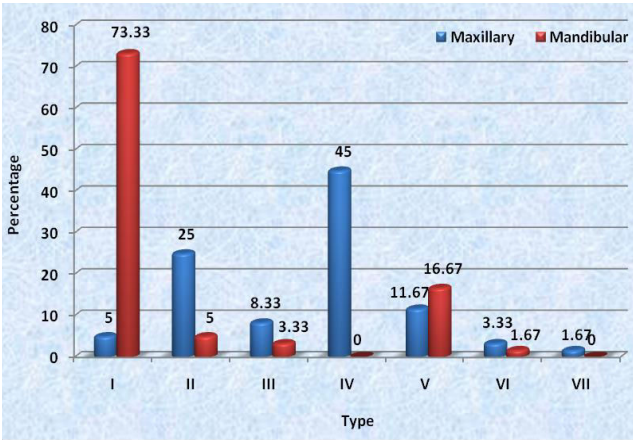
The different types of root canal systems found in 60 maxillary and 60 mandibular first premolars are depicted in Table I & Fig. I. It was observed that the canal anatomy of maxillary first premolars varied considerably.

Table I: Distribution according to type of canal configuration and type of teeth.

Type	Maxillary 1st premolar (n=60)		Mandibular 1st premolar (n=60)		χ^2	d.f.	p-value	Significance
	No.	%	No.	%				
I	3	5.00	44	73.33	27.980	1	<.001	HS
II	15	25.00	3	5.00	7.908	1	<.01	Sig
III	5	8.33	2	3.33	0.607	1	>.05	NS
IV	27	45.00	0	0.00	-		-	-
V	7	11.67	10	16.67	0.617	1	>.05	NS
VI	2	3.33	1	1.67	0.000	1	>.05	NS
VII	1	1.67	0	0.00	-	-	-	-

HS: Highly significant, NS: Non Significant, Sig: Significant

Fig. I: Showing the canal configurations in maxillary and mandibular first premolars.



Type I configuration was found in 3 teeth (5%) and 44 teeth (73.33%) in maxillary & mandibular premolar respectively. Value of χ^2 (Chi square) was 27.980 with the degree of freedom 1 (p value < 0.001) which is highly significant.

Type II canal configuration was found in 15 (25%) maxillary premolars and 3 (5%) mandibular premolars. The p value was <0.01 which is significant.

Type III canal configuration was observed in 5 (8.33%) maxillary and 2 (3.33%) mandibular premolars. The difference was insignificant (p > 0.05). Type IV canal configuration was found only in maxillary premolars (27 teeth;45%).

Type V configuration was found in 7 (11.67%) maxillary and 10 (16.67%) mandibular premolars. In maxillary premolars type VI configuration was seen in 2 (3.33%) and 1 (1.67%) in mandibular premolars. In both type V and type VI configuration the difference was insignificant.

Type VII configuration was only found in 1 (1.67%) maxillary first premolar.

The distribution according to the number of canals at the apex and type of teeth are presented in Table II & Fig. II. In maxillary first premolars 1 canal was found at the apex in 38.33% teeth and 2 canals in 61.67% of teeth, while in mandibular first premolars 1 canal was found at the apex in 81.67% teeth and 2 canals in 18.33% teeth. The difference was statistically highly significant (p<0.001). Therefore, it can be said that there is a significant association between the number of canals found at the apex and the type of teeth.

The distribution according to the number of orifices at the floor of the pulp chamber and type of teeth are shown in Table III & Graph III. In maxillary teeth 26.67% had 1 orifice and 73.33% had 2 orifices at the floor of the pulp chamber. Whereas, in mandibular first premolars 93.33% had 1 orifice and 6.67% had 2 orifices at the floor of the pulp chamber. The difference was statistically highly significant (p<0.001).

Table II: Distribution according to number of canals at apex and type of teeth:

No. of canals at apex	Maxillary 1st premolars		Mandibular 1st premolars	
	No. of teeth	%	No. of teeth	%
1	23	38.33	49	81.67
2	37	61.67	11	18.33

χ^2 = 23.472 d.f.=1 p < .001 HS

Fig. II: Showing the percentage of canals at the apex in maxillary and mandibular first premolars.

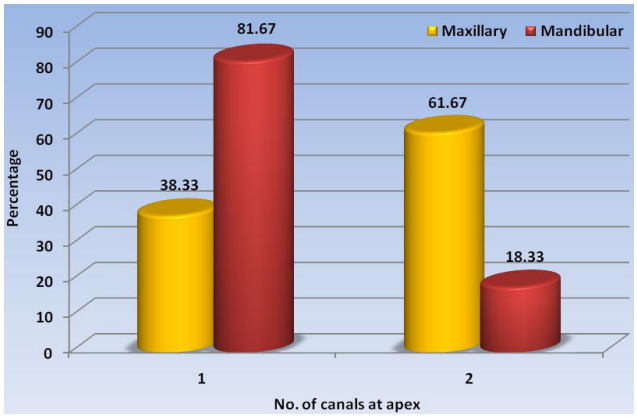


Table III: Showing the percentage of number of orifices present at the floor to pulp chamber in maxillary and mandibular first premolars.

No. of orifices at the floor of the pulp chamber	Maxillary 1st premolars		Mandibular 1st premolars	
	No. of teeth	%	No. of teeth	%
1	16	26.67	56	93.33
2	44	73.33	4	6.67

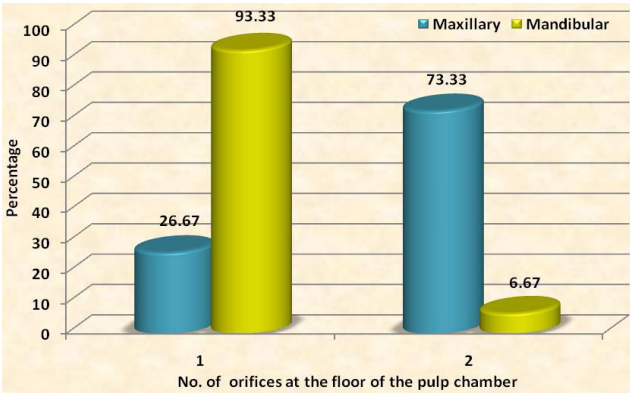
χ^2 = 52.82 d.f.=1 p < .001 HS

Discussion:

An accurate knowledge of the root canal morphology and its anatomical variations is required for successful root canal treatment. The variability of

root canal morphology is a challenge to both endodontic diagnosis and treatment. The identification of the internal morphology as precisely as possible is the primary step in root canal treatment. A complex root canal anatomy requires modifications in the access cavity (Rekha et al, 2005).

Fig. III: Showing the percentage of number of orifices present at the floor of pulp chamber in maxillary and mandibular first premolars.



Krasner & Rankow (2004) made a rationale approach to study the relationship of the pulp chamber to the clinical crown and pulp chamber floor. Their observations put forth in the form of laws are valuable aids to the Clinician in searching for elusive canals.

Various studies have reported variations in canal configurations in maxillary first premolars (Pineda & Kuttler, 1972; Green, 1973, Vertucei, 1984, Kartal et al, 1998) and mandibular first premolars (Baisden et al, 1992; Cleghorn et al, 2007; Velmurugan & Sandhya, 2009, Khedmat et al, 2010).

It is apparent from the literature that there is a divergence of opinion concerning the anatomical configuration of the pulp cavity of the maxillary and mandibular first premolar teeth. Vertucci in 1984 in his extensive study on root canal anatomy of human permanent teeth reported that maxillary first premolar was the only tooth which had all the eight types of canal configurations. He also reported that type-IV canal configuration was present in 1.5% of cases in mandibular first premolars. This is in variation with the present study in which type IV was not found. Type VII configurations was not found in the present study in mandibular first premolars which is in agreement with his study.

Pineda & Kuttler (1972) studied the normal root canal anatomy and its variations in both mesiodistal and buccolingual directions and found that in maxillary premolars 50.1% had one canal and 49.4% of teeth had two canals at the apex. While in mandibular first premolars 74.2% had one canal and 24.9% had two canals at apex.

This is in variation with the study of Green (1973). He reported 1 canal in 8% and 2 canals at apex in 92% of maxillary first premolars. While in mandibular first premolars he reported 1 canal in 86% teeth and 2 canals at apex in 14% teeth.

Baisden (1992) reported that 76% of mandibular first premolars demonstrated type-I and 24% had type IV canal configuration.

Iyer et al (2006) in their study reported that mandibular premolars exhibit a high degree of complex anatomy with fine ribbon shaped canal systems which are difficult to access, clean and obturate. The study was done using radiovisiography in different angulations to highlight the anatomical aberrations (Cleghorn et al, 2008; Moayedi s & Lata A, 2004).

According to Segovic et al (2004) the incidence of maxillary first premolars with 3 roots, 3 canals and 3 foramina is about 4-6%.

Sandhya et al (2010) conducted a study to assess the root canal morphology of mandibular first premolars in the Indian population using spiral computed tomography. The study showed that 80% of the teeth had a single canal, 11% had 2 canals and C-shaped canals were found in 2% of the teeth.

In the present study, root canal configurations were clearly visualized in 3-dimensions by using spiral computed tomography. It can therefore, be used as an adjunct to existing diagnostic aid especially in those areas where conventional radiographic methods give a complex picture. This information gained prior to the initiation of therapy will greatly help in successful subsequent treatment.

Since in India, there are different ethnic groups present, further studies of this nature are suggested to look for the variations in tooth morphology in different regions and reduce the incidence of failure by using advanced imaging systems.

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Research Article

A comparative evaluation of the fracture resistance of endodontically treated teeth with compromised intra radicular tooth structure using three different post system.

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Department of Prosthetic Dentistry, Maitri College of Dental Sciences and Research Centre, Bhilai, Government Dental College, Mumbai

Abstract:

Intra-radicular loss of tooth structure in endodontically treated teeth poses a challenge. Available methods for treatment are cast post-core, intra-radicular resin reinforcement using composite resin followed by placement of prefabricated metal/fibre post (glass or carbon).This study is an attempt to investigate the validity of treatment of such teeth using above methods and evaluate which post system is best suited for rehabilitation.

Thirtysix endodontically treated anterior teeth were prepared by uniformly removing intra-radicular tooth structure from buccal, lingual, mesial & distal surfaces such that only 0.75mm-1mm remained. Twelve teeth were subsequently restored with cast metal post & core, 12 with intra-radicular resin reinforcement followed by prefabricated titanium post (Luminex post system) & 12 with intra-radicular resin reinforcement followed by glass fibre post (Luscent Anchor post system). Statistical analysis used was t-test. There was no statistically significant difference between the 3 post systems, but it was observed that cast post & cores caused more apical & oblique fractures, rendering the teeth unrestorable. Teeth restored with intra-radicular resin reinforcement & placement of titanium or glass fibre post failed with root fractures limited to the coronal aspect along with dislodgement of post. Intra-radicular resin reinforcement offers advantages like preventing the metal display of the post through the thin dentinal wall, reinforcement of the thin walled teeth & comparable fracture resistance to cast post and core.

Key words: Intra-radicular resin reinforcement, cast post & core, titanium post, glass-fibre post, smooth light transmitting plastic post.

Introduction:

Increased emphasis on the maintenance and preservation of natural dentition combined with an increase in the predictability and effectiveness of endodontic therapy, has made their post endodontic restoration a great challenge. Endodontics & Prosthodontics go hand in hand to retain pulpless, badly broken down teeth that would have been otherwise deemed fit for extraction & thereby reinstating them as a functional member of the masticatory system. Pulpless teeth frequently remain intact after endodontic treatment with conservative access preparation. However, if the remaining tooth structure is thin and fragile, fracture of such teeth is not uncommon (Caputo & Standle, 1976; Hunter et al, 1989; Saupe et al, 1996; Tjan &Whang 1985; Trabert et al, 1978; Trope & Ray, 1992). For years, posts have been thought to be providing reinforcement to pulpless teeth against fracture, though, recent workers have strongly contradicted this statement emphasizing the role of posts more as means of providing retention for the core (Caputo & Standle, 1976; Deutsch et al, 1983; Sapone & Lorencki, 1981; Sokol, 1984; Sorenson & Mortinoff, 1984). Cast posts and cores have been favoured to provide coronoradicular stabilization in varied clinical conditions (Morgano & Milot, 1993; Perel & Muroff, 1972; Sheets, 1970). Recently with the advancement of their physical & mechanical properties there has been an increase in the use of adhesive technology (Freedman et al, 1994; Godder et al, 1994; Lui, 1992; Morgano & Milot, 1993). Luminex post system and Luscent Anchor post system have been introduced for intra-radicular resin reinforcement, wherein a smooth light transmitting plastic post (used in Luminex post system) and a glass fibre post (used in Luscent Anchor System) is used for polymerization of light cure composite which is placed intra-radicularly to resurface the fragile radicular walls with composite & there by reinforce them.

The present study was under taken to evaluate & compare under controlled laboratory conditions the fracture resistance of teeth with compromised intra-radicular tooth structure restored with cast post & core, Luminex post system and Luscent Anchor post system respectively.

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Materials and Method:

Thirtysix freshly extracted central incisors which were stored in normal saline from the time of extraction to the time of final testing, were randomly divided into 3 groups:-

Group A:Teeth to be restored with cast post & core.

Group B:Teeth to be restored with intra-radicular resin reinforcement using smooth light transmitting post followed by placement of Luminex titanium post and composite core.

Group C:Teeth to be restored with intra-radicular resin reinforcement using smooth light transmitting post followed by placement of Luscent Anchor glass fibre post & composite core.

Post space preparation:

Access cavity for endodontic therapy was established in a conventional manner. Teeth were instrumented upto a size of no. 45 (international standardization organization size). The canals were obturated by lateral condensation. After endodontic treatment of all the teeth they were sectioned till 15mm of total length remained. Gutta-percha was then removed from each canal until 4mm of root canal filling material remained at the apex.

To simulate extensive clinical damage the canal space of each root was further prepared by routing out the internal dentin surface using motor driven Pessos reamers, leaving the test specimens with 11mm dowel space length within the canal and a residual dentinal wall thickness of 0.75 to 1.00 mm at cemento-enamel junction. Each residual root was measured on buccal, palatal and proximal aspects at 2.50, 5.00 and 7.00 mm below the occlusal surface for uniformity in thickness (0.75-1.00mm). Fig I. A no: 5 classic post system reamer (Dentatus, USA) was then used to produce a positive seat centered in the apical 2.00 mm of each 11mm dowel space. A counter bevel was given to all specimens coronally to provide a ferrule to the teeth such that the crown margins would be placed on sound tooth structure and apical to tooth core interface (Saupe et al, 1996).

Cast metal post & core were fabricated for 12 teeth of group A in nickel chromium alloy (Durabond) & cemented with self cure adhesive resin, Hi-X post cement (Bisco Inc., Schaumburg).

For the resin reinforced group, 12 teeth grouped under group B & C were prepared similar to group A till the last step, except for the placement of the type of post.

Teeth in group B & C were readied as follows: Unietch 32% phosphoric acid gel (Bisco Inc Schaumburg) was used to etch the intra-radicular dentin for 15 seconds & rinsed with water for 30 seconds & dried. The application & curing of bonding agent(5th generation one step bonding agent- Bisco, Inc., Schaumburg) was followed by injection of Aeliteflo™ low-modulus flowable composite (Bisco Inc., Schaumburg) into the canal. A no: 6 smooth light transmitting plastic post (SLTP) of the Luminex post system (Dentatus, USA), was inserted & centered in to the positive seat of the dowel space till predetermined length of 11mm indicated by rubber stop. The post was cut such that only 3-4mm of post projected out of the tooth. The resin was cured for 60 seconds with the post inside & for 20 second after removal of the post. To further reduce the lumen of the canal, a no: 5 (SLTP) was inserted after injecting the flowable composite inside the tooth. This step ensures to resurface the voids if any & to reduce the canal lumen to desired diameters of 1.05mm.

This was followed by luting of no. 5 titanium (Dentatus, USA) post in group B & 1.6 mm diameter of glass fibre post of the Luscent Anchor post system (Dentatus, USA), in group C, using Hi-X self cure resin cement (Bisco Inc., Schaumburg). A core of 5mm height was built up on the group B & C teeth with Biscore TM dual cure core build-up material (Bisco Inc., Schaumburg) and finally were finished & polished (Fig. II & Fig. III).

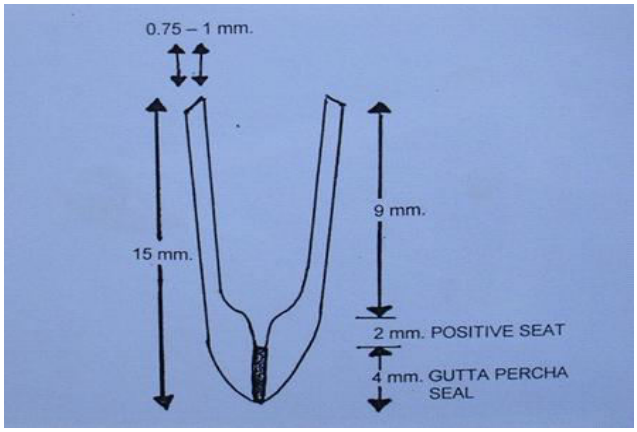

Fig. I: schematic representation of the desired tooth preparation for a structurally weakened design.

All 36 teeth were then given cast coping made with nickel chromium alloy (Durabond) which were cemented with zinc phosphate cement (Powers, 2002). The copings were given an indention on the palatal side at 130° to the long axis of the tooth, 1mm away from the incisal edge to facilitate proper placement of the pointer tip of loading machine (Fig. IV). Sample teeth were then mounted in acrylic block,shaped as equilateral triangles of 60°, such that the long axis was

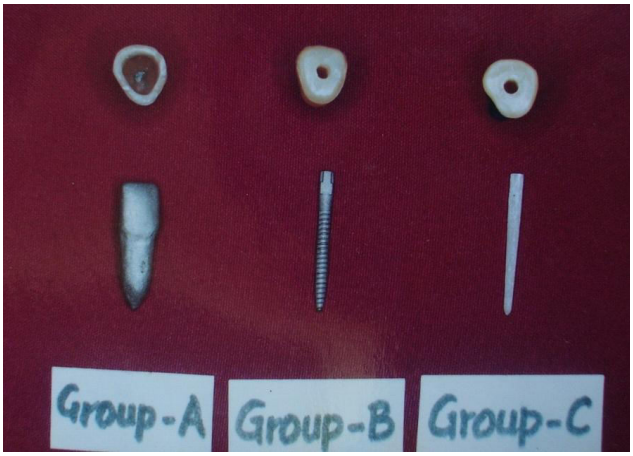

Fig. II: Canal width and post diameter of group B and C after IRR as compared to Group A which was to receive cast post and core.

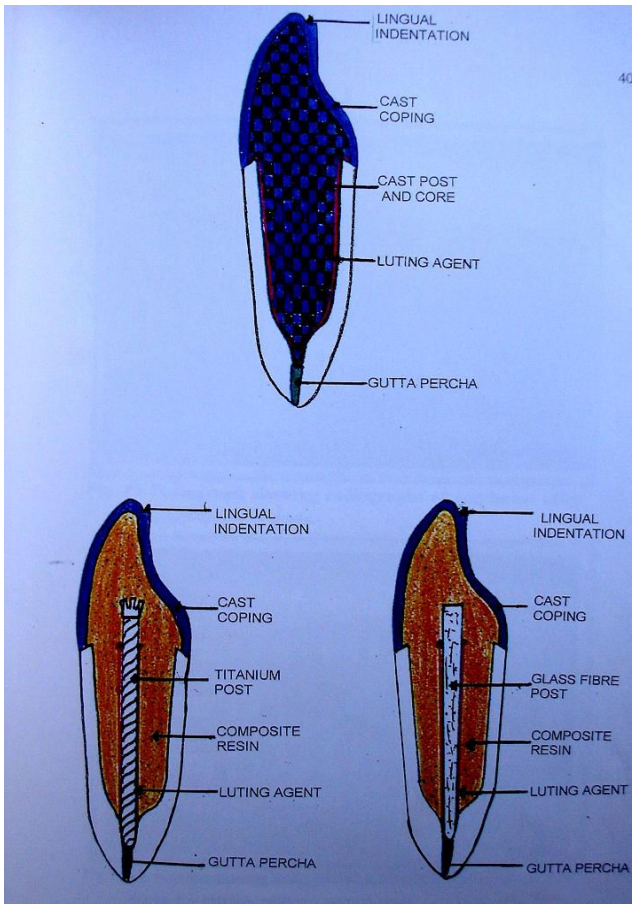

Fig. III: Schematic representation of the specimen following cementation of the post systems in their respective groups.

perpendicular to the inclined surface with their lingual surface facing upwards. This placed the pointer in the lingual indentation of the coping and angle of 130° between the long axis of the tooth & the pointer of the loading jig was formed (Deutsch et al, 1985; Guzy & Nicholls, 1979; King & Setchell, 1990; Stern & Hirschfield, 1973) (Fig. V). The samples were tested on a universal testing machine Instron, which was set at a cross head speed of 5mm/min.

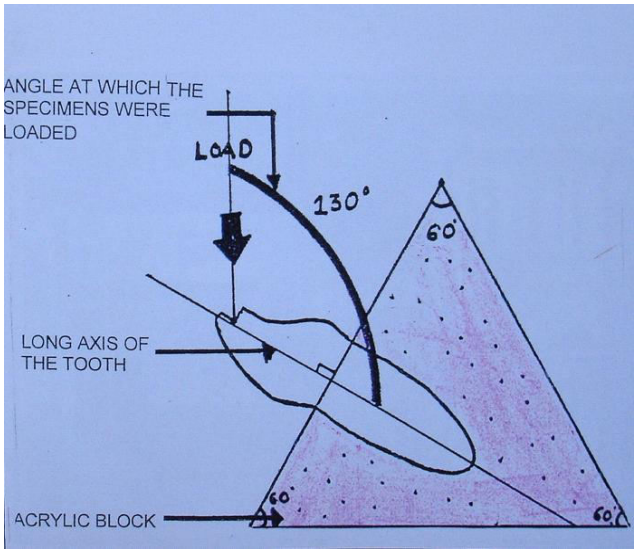

Fig. IV: Schematic representation of a mounted specimen prior to testing.

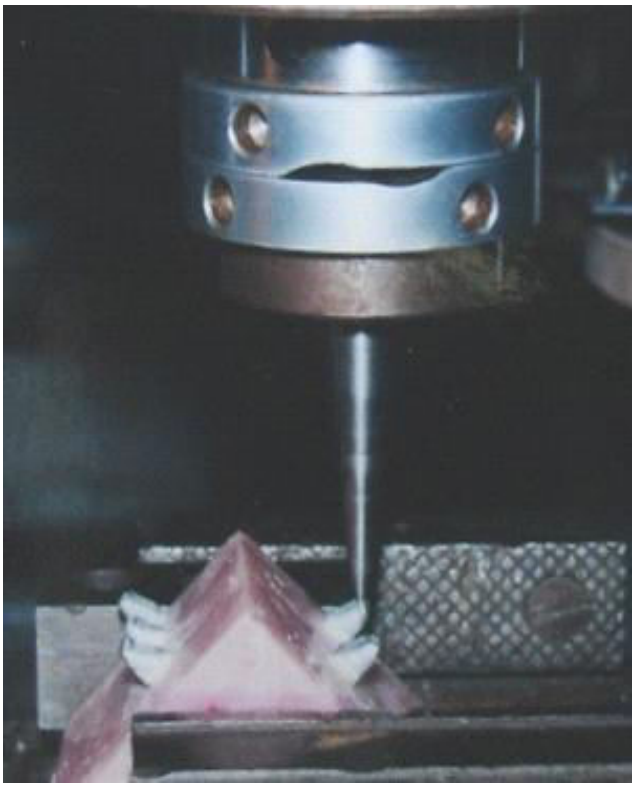

Fig.V: Testing of the samples on the Instron machine.

Result :

The results were compared by using t-test and it was found that there was no statistically significant difference between the fracture resistance of teeth in group A, B &C. However, when the mode of failure was compared, the fractures occurring in teeth

with cast posts and core (Group A) were more extensive in vertical and oblique in direction, rendering the teeth non restorable and necessitating extraction. None of the teeth restored with intra-radicular resin reinforcement and placement of titanium or glass fibre post failed with extensive root fractures (Group B&C). The fractures in these two groups were at the dentin-core interface, with a few posts fracturing along with a part of dentin core interface (Fig. VI).

The mean failure load observed was

a) Cast post & core (group A): 0.7758 KN
b) Intra-radicular resin reinforcement with Luminex post & composite core (group B) : 0.6483 KN
c) Intra-radicular resin reinforcement with Luscent Anchor post& composite core (group C): 0.7083KN

Difference in the mean failure load observed between group A, B & C is depicted in Table I.

Table I: Comparative evaluation of differences between means.

COMPARISON	DIFFERENCE OF MEANS
1) Cast post and core *vs* Intra-radicular resin reinforcement and Luminex titanium post.	0.7758-0.6483=0.1275
2) Cast post and core *vs* Intra-radicular resin reinforcement and Luscent anchor glass fibre post	0.7758-0.7083=0.0675
3)Intra-radicular resin reinforcement and Luminex titanium post vs Intra-radicular resin reinforcement and Luscent Anchor glass fibre post	0.7083-0.6483=0.0600

NS :Non significant:p>0.05 (by t-test)

Fig. VII: Mean fracture resistance in (KN).

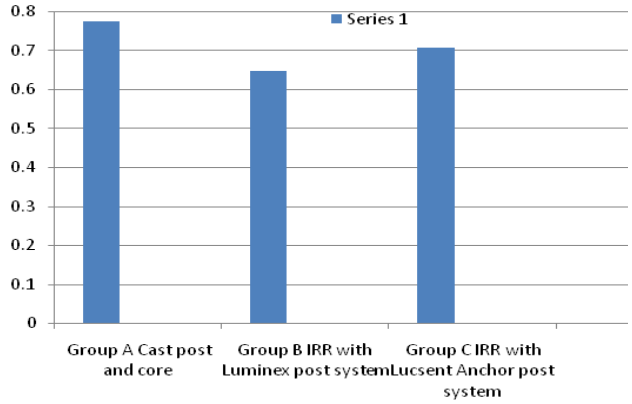

Fig.VI: Mode of fracture of posts in Group A, Group B and Group C (Fom right to left).

Discussion:

Preservation of existing tooth structure while restoring the tooth is mandatory. An ideal post should provide retention & resistance to displacement of core coupled with esthetics. A post is no longer associated with the reinforcement of endodontically treated tooth (Caputo & Standle, 1976; Hunter et al, 1989; Saupe et al, 1996; Tjan & Whang, 1985; Trope & Ray, 1992). An over-enlarged post space, either created by operator or as an outcome of dental disease, is at a risk of fracture during insertion, cementation of post or subsequent function. Internal stresses are greater as post diameter increases, resulting in reduced thickness of the remaining dentinal wall. Thus, the fracture resistance of the root is directly related to the amount of remaining tooth structure. Cast post & cores were advocated in compromised radicular tooth structure cases as they were thought to require less instrumentation. Enhanced fracture resistance was believed to be present as it is a one body, post & core restoration with a ferrule effect (Lui, 1992; Morgano & Milot, 1993; Perel & Muroff, 1972). But it has some inherent disadvantages like

a) arduous fabrication,
b) more number of sittings,
c) dependence on skill of the laboratory technician,
d) tapered shape causing high stress concentrations,
e) high modulus of elasticity, which has a potential to concentrate and transfer stresses applied to the surrounding tooth structure
f) more vertical/oblique root fractures rendering the teeth deemed for extraction.

Standlee et al (1972), Henry (1977), Mattison et al (1984) have shown that tapered posts produced high stress concentrations when cemented and loaded, thereby causing more fractures than parallel-sided posts. Morgano & Milot (1993) reported a high rate of failure of cast post and cores as compared to alternative systems of corono-radicular stabilization. In the present study, results are consistent with the studies of Chan & Byrant (1982). Sorensen & Martinoff (1984) have reported high incidence of root fractures in teeth treated with tapered cast posts and cores. Teeth with Intra-radicular resin reinforcement & placement of glass or titanium post showed no failures or extensive root fracture. The fractures, in both the groups were at dentin-core interface, a few fracturing along with a part of dentin-core interface. The replacement and reinforcement of intra-radicular tooth structure with a material like composite, whose modulus of elasticity is compatible with that of dentin has shown to be a far better treatment option, as compared to cast post and cores. The results are contrary to the results achieved by Saupe et al (1996) who compared fracture resistance of cast post and cores to intra-radicular resin reinforced teeth with Luminex post and cores.They concluded that the fracture resistance was higher in the later group. However, their study had a limitation that the cores were directly loaded as compared to their clinical counterparts.

Furthermore, material property of the post has been shown to affect the stress distribution, which is more favourable when two substances of equivalent or near about similar modulus of elasticity approximate each other. Thus considering that the modulus of elasticity of dentin is 20G pa, a glass fibre post (modulus of elasticity 40Gpa), would be the best post material. Ceramic post (69 Gpa), titanium post (120 Gpa) and Carbon fibre post (120 Gpa) would also be good post materials as compared to base metal alloy post (200 Gpa) or a Steel post (210 Gpa) with respect to stress distribution (Powers, 2002; Martelli, 2000).

Clinical significance:

Intra-radicular Resin (IRR) reinforcement promises to be a viable treatment alternative to cast post and core in treatment of endodontically treated teeth with thin dentinal walls, with following advantages:

a) single sitting procedure.
b) total control of the dentist over the procedure.
c) facility to provide a smaller diameter post.
d) esthetic restoration by masking the metal display of the post through the thin dentinal walls by the intervening thick core of composite.
e) fracture resistance of the titanium or glass fibre post after IRR comparable to cast post and core.

Conclusion:

Following are the conclusions of the study:

1) No statistically significant difference was observed in the resistance to fracture between teeth restored with cast post and core and either groups of intra-radicular resin reinforcement followed by placement of Luminex titanium post or Luscent anchor post.
2) The groups of intra-radicular resin reinforcement showed failure at the post/core interface, sometimes showing fracture of the core along with some part of the tooth-core interface. No radicular fractures were seen, thereby making the teeth more amenable to retreatment.
3) A cast post and core can cause areas of stress concentration making the endodontically treated tooth susceptible to vertical & oblique direction fracture, deeming the tooth non-restorable.
4) Luminex and Luscent Anchor post Systems that utilize placement of composite resin to replace the lost intra-radicular tooth structure prior to the placement of metallic and glass fibre post respectively, have the potential to reinforce teeth.

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Research Article

Curbing the growth of candida-A comparative *in-vitro* study

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Abstract:

Endodontics is the least forgiving branch of dentistry in terms of success or failure. Therefore, re-treatment has become a significant part of today's endodontic practice. There is a growing evidence showing the presence of fungi especially Candida albicans in root canals of obturated teeth in which endodontic treatment has failed. It has been demonstrated that Candida species are resistant to some medications used in endodontics. The aim of this study was to examine the *in-vitro* susceptibility of Candida albicans to materials used in endodontics such as mineral trioxide aggregate (MTA), Calcium hydroxide $Ca(OH)_2$/camphorated paramonochlorophenol (CMCP) /glycerine and chlorhexidine (CHX).

MTA and CHX are effective anti-fungal agents each with 67% anti fungal activity while $Ca(OH)_2$/CMCP showed 33% anti-fungal activity.

Key Words: Candida albicans; MTA; Calcium hydroxide / CMCP / glycerin; chlorhexidine; tubedilution test.

Introduction:

The aim of endodontic treatment is to eliminate infections from the root canal and prevention of reinfection (Nair et al, 1990). Micro-organisms isolated from primary endodontic infections are predominantly strict anaerobes. On the other hand, facultative anaerobic bacteria and yeasts prevail in therapy-resistant cases and chronic apical periodontitis as they are more resistant to antimicrobial agents usually used in endodontics (Ferrari et al, 2005; Siqueira (Jr), 2001).

The incidence of yeasts, specially Candida albicans (C. albicans) ranges from 7 to 55% in therapy resistant cases and can be greater in individuals with local or systemic factors predisposing to mycoses (Siqueira (Jr) & Sen, 2004). In all such situations, it becomes mandatory to use anti-fungal agents in one form or the other (Siqueira et al, 2002; Waltimo et al, 1997; Sequeira & Rocasl, 2004; Fergusian et al, 2002).

Therefore, the purpose of this study is to examine the *in-vitro* susceptibility of C. albicans to agents used in endodontics such as MTA, CHX and $Ca(OH)_2$ / CMCP using the tube dilution method.

Material & Method:

Pure culture of Candida albicans (MTCC 227, batch – Nov 2003, Chandigarh) was added to 2 test tubes each containing 10 ml Sabouraud's broth and incubated at 37^0C for 7 days. The cell viability of C. albicans was checked by inoculation in Sabouraud's dextrose broth and plating onto Sabouraud's dextrose agar plates. The cells were also observed under microscope to check their viability.

One ml of Sabouraud's dextrose broth was taken in 24 test tubes and to each, 1 ml suspension of viable C. albicans suspension was added. The tubes were divided into four equal groups. Three hundred mg of MTA, $Ca(OH)_2$ /CMCP/glycerin and CHX were added to all the six tubes of group 1,2 and 3 respectively. In group 4, no medicament was added and it served as a negative control.

All the test tubes were incubated at 37^0C for 5 days after which 0.1 ml sample from each was transferred to test tubes containing 1 ml Sabouraud's dextrose broth, vortexed and incubated at 37^0C for 7 days. After 7 days, samples from each test tube were streaked on Sabouraud's dextrose agar plates. Growth of C. albicans was observed.

Statistical analysis was done by using the Kruskal Wallis method.

Observations:

The growth of Candida albicans was significantly inhibited in group 1 with MTA as compared to the control. Four samples showed complete inhibition where as 2 samples showed 1-2 colonies of C. albicans.

Group 2 containing $Ca(OH)_2$ - CMCP- glycerin showed less inhibitory effect on the growth of C. albicans; 2 samples showed complete inhibition while 4 samples showed 3-4 colonies of C. albicans.

Group 3 with CHX showed significant inhibition of C. albicans with 4 samples showing no growth and 2 samples showing 1-2 colonies. All the tubes of group 4 were positive for C. albicans growth.

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Tabel I: Comparison of anti-candidal activity between various groups.

Groups	Fungal Growth		Total	Difference between Groups		
	+	-		II	III	IV
I	2	4	6	P = 0.45 NS	No Difference	P<0.05 Significant
II	4	2	6	-	P = 0.44 NS	P=0.34 NS
III	2	4	6	-	-	P<0.05 Significant
IV	6	-	6	-	-	-

Chi squire = 7.5 P = 0.05 Significant NS = not significant

Statistical analysis showed significant anti-fungal action by MTA and CHX ($p < 0.05$). Where as no significant difference was observed between group 2 and group 4 ($p > 0.05$).

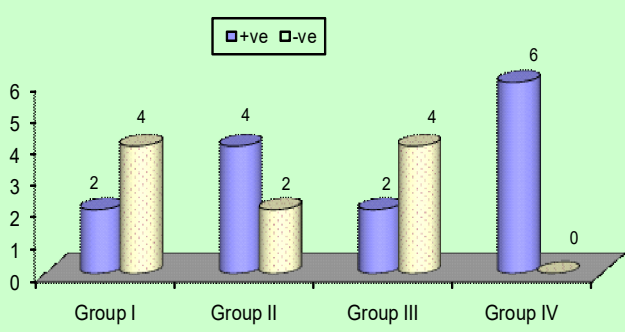

Fig. I: Bar-diagram showing antifungal activity of various groups.

Discussion:

Yeasts have been demonstrated in the Plaque, Caries, Dentinal tubules, Sub-gingival flora, Root canals and Peri radicular tissues (Siqueira (Jr), 2003).

C. albicans was chosen as a test organism in this study because it has been found in infected root canals, peri-radicular tissue, persistent infections and in apical periodontitis. It is a dentinophillic organism and lodges in the dentinal tubules using the calcium in the dentin for its nourishment (Waltimo et al, 1997).

The method used in this study is the tube dilution susceptibility test which is an effective method to evaluate the antifungal and antibacterial properties of any filling material / solution. It allows direct contact between fungal cells and the test agents (Al-Nazhan & Al-Judai, 2003).

Mechanisms of pathogenicity of C. albicans is due to:(i) its power of adaptability to a variety of environmental conditions attributable to the switching of gene expression dictated by environmental changes, (ii) it adheres to a variety of surfaces by surface molecules that mediate adherence to host tissues, (iii) it produces hydrolytic enzymes which result in the degradation of extra-cellular matrix proteins, (iv) C. albicans has the ability to form biofilms on different surfaces,
(v) evasion and immunomodulation of the host defenses by different mechanisms and (vi) dentinophillic nature of candida (Sen et al, 1997). Mineral trioxide aggregate had been developed in 1994 to seal pathways of communication between the root canal system and the external surface of the tooth. It elicits minimum inflammatory response, exhibits low toxicity, good sealing ability, bacteriostatic and fungicidal effects. Its anti-fungal property is said to be due to its high pH (Al-Nazhan & Al-Judai, 2003; Schwartz et al, 1999).Chlorhexidine is a dicationic molecule effective against bacteria and fungi. Its mode of action is membrane disruption and it is known for its substantivity (Newman et al, 2003).

Calcium hydroxide / CMCP has the property to hydrolyze the lipid moiety of bacterial lipopolysaccharides and making them incapable of producing toxicity and pathogenicity (Foreman & Barnes, 1990; Zamany et al, 2003).

Its dental use relates chiefly to its ability to stimulate mineralization and its antibacterial properties. C. albicans has demonstrated resistance to some intra canal medicaments including calcium hydroxide when used with inert vehicles such as water, saline and glycerine. Evidence suggests that the association of $Ca(OH)_2$ with CMCP has broader anti-microbial spectrum and a higher radius of antibacterial action. The pastes of $Ca(OH)_2$ and CMCP in glycerine shows pronounced anti-fungal effect also. Camphorated paramonochlorophenol consists of 2 parts of para chlorophenol and 3 parts of gum camphor. Camphor not only serves as a vehicle and diluent but also reduces the irritating effect of pure MCP and prolongs the anti-microbial property.

All the above agents show their anti-fungal property due to their high pH which increases the permeability of cell membranes with leakage of intracellular components (Al-Nazhan & Al-Judai, 2003; Schwartz et al, 1999; Zamang et al, 2003). Therefore, these agents can be widely used in endodontics and knowledge about their anticandidal property would be beneficial in eliminating C. albicans from the root canal system.

Conclusions:

MTA and CHX are effective anti-fungal agents each with 67% anti fungal activity. $Ca(OH)_2$/CMCP showed less effective anti-fungal activity at 33%. As

MTA is cost prohibitive, CHX could be the material of choice when the root canal culture shows the presence of C.albicans. However, further *in-vivo* studies are required before we can definitely say what the action of these agents would be in the root-canal system.

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Research Article

Morphometric Analysis of Mental Foramen in Human Mandibles of South Gujarat:

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Abstract:

Mental Foramen is found on the anterolateral aspect of the mandible and transmits mental nerves and vessels. The knowledge of anatomical morphometry of mental foramen is essential in clinical dentistry when administering regional anesthesia and performing periapical surgery in the mental region of the mandible. Mental nerve leaving the foramen is anesthetized during the dental procedures, suturing of soft tissue lacerations of mouth and biopsy. The aim of the study was to elucidate the morphological features and precise anatomical position of the mental foramen with reference to surrounding anatomical landmarks in an adult South Gujarat population, the area where this information is scanty. This study was conducted using 100 dried human mandibles of unknown sex obtained from the Department of Anatomy, S.M. Institute of Medical Education & Research and Government Medical College, Surat. The parameters including size, shape, number, location and dimensions of mental foramen with respect to the surgically encountered anatomical landmarks were studied. In most of the cases the foramen was oval in shape and situated in the line with the longitudinal axis of the 2nd premolar tooth. Its usual opening was in a postero-superior direction.

Key Words: Mental Foramen (MF), Morphometry, Surgical landmarks, Dental Procedures.

Introduction:

Mental Foramen (MF) is an important anatomical landmark to facilitate surgical, local anesthetic and other invasive procedures for dental surgeons performing periapical surgery in the mental region of mandible. Its location and the possibility that an anterior loop of the mental nerve may be present mesial to the MF and needs to be considered before any surgery in the foramina area in order to avoid any nerve damage. The MF is situated bilaterally on the anterolateral aspect of the mandible, down to alveolar margin. The mental nerve and vessels emerges through the mental foramen and supply sensory innervation and blood supply to the soft tissues of the chin, lower lip and gingiva (Sinnathamby, 1999; Berry et al, 2000). But the position of MF vary among racial groups and genders (Cutright et al, 2003; de Freitas et al 1976; Green, 1987). Despite the significance of MF, little attention has been given to the study of the morphology, most common location of foramen and associated anatomical characteristics in South Gujarat, hence this study has been conducted to investigate the number, size, shape, dimensions and location of MF with respect to the surgically encountered anatomical landmarks.

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Material and Methods:

100 dried adult human mandibles with complete dentition and intact alveolar margin of unknown sex obtained from the Department of Anatomy, S.M. Institute of Medical Education & Research and Government Medical College, Surat, were used for this study. The shape, size, location, number of MF, direction of opening of mental foramen were measured on both sides of mandible by using digital Vernier caliper.

The shape of MF observed was either oval or rounded. Mean horizontal and vertical diameters were measured. Location of MF was identified by using following parameters: (1) Distance from mental foramen to mental symphysis; (2) Distance from mental foramen to alveolar margin and (3) Distance from mental foramen to inferior border of the mandible. The position of MF was noted in relation to mandibular teeth. The direction of opening of MF was recorded as postero-superior, superior, lateral, antero-superior, posterior or anterior (Phillips et al, 1990). A comparison of the mean values between sides was performed using the t-test, p-value<0.05 was considered statistically significant.

Observations:

Morphometric features of 100 dried human mandibles revealed that the number of MF on each side was single in 97.4%cases,whereas double in 2.6% cases as shown in Fig.I. The shape of foramen was oval in 92% cases and rounded in 8% cases as seen in Fig. II.

Fig. I: Showing double mental foraman.

Fig. II: Showing rounded mental foraman and is in line with first molar teeth.

Mean horizontal diameter was 3.33mm on right side and 3.25mm on left side with range of 2.1-6.2mm,whereas mean vertical diameter was 2.15mm on right side and 2.13mm on left side with range of 1.8-3.1mm. The linear measurements of MF with respect anatomical landmarks are given in Table I. The position of mental foramen in relation to mandibular teeth on the two sides are shown in Table II. The most frequent position of foramen in relation to the teeth was in line with the longitudinal axis of 2nd premolar for both right (81.55%) and left (81.50%) sides. The second common position was in the line of 1st molar teeth (right 7.9%; left 7.8%) as shown in Fig.II, followed by in line between 1st & 2nd premolar (right 7.8 %; left 7.6 %); least common position was in the line between 2nd premolar & 1st molar teeth (right 2.7 %; left 3.1 %).

The direction of exit of the MF was postero-superior in 92%, followed by superior in 3.3%, laterally in 3.3%, and posterior in 1.4% of the mandibles.

Table I: Morphometric measurements of the mental foramen between two sides.

Characteristic	Right side (mean±SD)mm	Left side (mean±SD)mm
Distance between MF and symphysis menti	25.55±5.07	25.05±5.07
Distance between MF and alveolar margin	14.05±3.05	13.82±3.06
Distance between MF and lower border of mandible	12.16±3.04	12.11±3.11

Table II: Frequency of the location of mental foramen in relation to mandibular teeth between the two sides.

Location	Right side	Left side
In the line with the second premolar	81.55%	81.50%
Between second premolar and first molar	2.75%	3.1%
Between first and second premolar	7.8%	7.6%
In the line with first molar	7.9%	7.8%
In the line with the first premolar	0%	0%

Discussion:

The precise identification of position of the mental foramen is important in both diagnostic and clinical procedures of the mandible. Clinically, mental nerve bundle emerging from the mental foramen may get injured during surgical procedures with resulting paresthesia or anesthesia along its sensory distribution (Phillips et al, 1990). Anatomically, the mental foramen is the opening of the mental canal. According to standard text books, mental foramen is most commonly situated between the apices of the first and second lower premolar (Sinnathamby, 1999; Berry et al, 2000). Although this is in accord with some European population, but this is an exception to other populations (Green, 1987; Phillips et al, 1990; al Jaser et al, 1998; Ari et al, 2005; Shankland, 1994; Ilayperuma et al, 2009). Racial variation in the position of the mental foramen is clearly demonstrated. The modal position of the mental foramen in Chinese was in the line with the second premolar whereas in Britishers, it was between the first and second premolars (Santini & Land, 1990). It was also interesting to note that the mental foramen was positioned more posteriorly in Blacks than in Whites (Cutright et al, 2003). However, the most common

position of mental foramen in the present study was in the line with the long axis of the second lower premolar followed by in the line with the first molar tooth. This was in agreement with previous studies on other Asians like, Asian Indians, Thai and Malay populations (Shankland, 1994; Ngeow & Yuzawati, 2003).

During the early prenatal life mental foramen is located in the alveolar bone between the primary canine and first molar (Kajaer, 1989). Therefore, it is speculated that positions other than the most common ones are due to a lag in prenatal development.

The opening of the mental canal was postero-superiorly in majority of the subjects (92%). This was in agreement with previous studies (Boonpiruk, 1975; Mwaniki & Hassanali, 1992). The mean horizontal diameter of 3.33 mm, observed in the present study is also consistent with the corresponding figures of 2.93mm observed in west Indians (Oguz & Bozkir, 2002), although it was smaller than the diameters of 5.03 mm reported for Nigerians (Olasoji et al, 2004).

The mean distance from the mental foramen to the symphysis menti in the present study was 25.55±5.07mm on the right side and 25.05±5.07mm on the left side (Ilayperuma et al, 2009). There was no significant side difference either in the position or the morphometry of the mental foramen in South Gujarat populations. From a clinical point of view, information regarding the mean distance from symphysis menti to mental foramen in a given population has a significant implication. Generally, the mental foramen is difficult to localize as there are no absolute anatomical landmarks for reference (Phillips et al, 1990). As the mental foramen can not be clinically visualized or palpated, in clinical situations, it is localized in relation to the lower teeth. However, clinically there may be instances where the mental foramen can not be localized in its modal position in patients without a reference tooth or malposition of tooth. In such cases, mental foramen can be accurately localized if the distance from the symphysis menti is known.

Conclusion:

The present study reveals valuabled insights on the information concerning the morphology of mental foramen in South Gujarat population. The knowledge of the distances from surgically encountered anatomical landmarks in the present study provide valuable information to dental surgeons that will facilitate effective localization of the neurovascular bundle passing through mental foramen thus avoiding complications from local anesthetic, surgical and other invasive procedures.

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Research Article

A cross sectional study on demographic profile and role of education in adolescent girls

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Abstract:

Adolescent is a period of rapid growth and maturation in human development. It is a crucial period of women's life where sociocultural factors not only influence her health but also health of future generation. Hidden behind the socially sanctioned cloak of marriage, underage girls are deprived of their personal freedom, forced into non-consensual sex, exploitation of their labour and discrimination of their educational development and individual life choices. A community based cross sectional study was carried out among 250 adolescent girls aged 13 -19 years. This age group was considered for the study because of marked acceleration of physical and emotional development which occurs during this period. Aim of this study was to find out the incidence of early marriage and pregnancies among adolescent girls and the impact of education. It was observed that 18.8% of adolescents were married and 8.4% were pregnant at one or the other time. Pressure of elders was the major reason for early marriage (53%) and early pregnancy (57%) among married girls. The education of adolescent girls plays a major role on the marital status and awareness of the health problems.

Key words: Adolescent girls, Early pregnancies, Marriage education.

Introduction:

Nature and nurture are two important factors in the flowering of an individual's personality. Like the budding flower, the adolescent girl needs caring environment at home, supported by a friendly, emphatic and sensitive health system to help her to bloom and mature into healthy women for development of family, society and country. This period is very crucial since these are the formative years of life of an individual when major physical, psychological and behavioural changes take place. This is also a period of preparation for undertaking greater responsibilities in future, including responsibility of healthy parenthood. It is a tragedy that in developing countries including India, some of these blossoms are nipped in the bud.

High rates of adolescent childbearing found in South and South-West Asia are obviously related with early age at marriage. Bangladesh has one of the highest levels of adolescent childbearing, followed by Nepal and India (Nair, 2004). Out of 4.5 million marriages that take place in India, three million marriages occur in girls of 15-19 years age group. Married adolescent girls comprises of 20/1000 population. Rani & Lule (2004) found that 6% of urban and 21% of rural women aged 15-19 years were married before the age of 15 years). Furthermore, they are subjected to life threatening damage to their health by having to go through pregnancy and child birth before their bodies are sufficiently mature to bear the burden. Therefore, there is a need to address the special needs of this vulnerable group. In this perspective, the present study was undertaken to find out the incidence of early marriage and pregnancies among adolescent girls and the impact of education.

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Material and Methods

The present study was a community based cross-sectional study, carried out among 13-19 years old adolescent girls of an urban community-Rajapur, which is a field practice area of Department of Community Medicine, M. R. Medical College, Gulbarga. The population of Rajapur was 3380. The area was selected as it was the training center and it was expected that due to the services rendered, people would be more cooperative. The study was carried out from April 2004 to March 2005.

Adolescent girls constitute 10% of female population (Kumar & Sharma, 1999). WHO expert committee (1974) proposed that the age limit of 10 to 19 years be used to identify adolescent, but there is no statutory legal age limit of when the adolescence begins and ends. Probably developmental changes are the better markers rather than age limits, as there is a marked acceleration of physical and emotional development between age of 13 to 19 years (Wani, 1999). We decided to include all the adolescent girls

aged 13-19 years, residing in the study area. Thus we studied 250 adolescent girls who have completed 13 years of age and all those who have not completed 20th years. Due care was taken to ensure that the families of the study subject were a permanent resident of Rajapur. In present study the interview technique was used maintaining full privacy. The objectives of the study were explained to families before interviewing them to ensure co-operation. The information was collected in the pre-designed and pre-tested semi structured interview schedule. Data was collected for occupation, type of family, age at menarche, age at marriage, age at first pregnancy, literacy status of girls, reasons for early marriage and pregnancy operational definition used for classification of educational label were; (a) illiterate-one who could not read or write with understanding in any language, (b) primary school-from class one to seven, (c) secondary school-eighth to tenth class, (d) higher education – PUC or equivalent and degree. Knowledge regarding health related issues was collected by asking 25 questions related to important health issues like, legal age of marriage, adverse effect of too early, too close, too many pregnancies, prevention of HIV/AIDS, contraception methods etc. The data was analyzed by the scoring system. The best score for knowledge was 100 followed by as >81 as good, 51- 80 as fair as and lower than 50 as poor awareness regarding health. Data was coded and analyzed by microsoft window excel 2007 with chi-square test and frequency distribution. In the absence of the respondent during the first visit, repeat visits were paid to contact them.

Results:

Out of 250 adolescent girls studied, 18.8 % were married and majority of them 63%, belonged to a nuclear family. The literacy status indicated that 31(12.4%) were illiterates, 66 (26.4%) had primary education, 92 (36.80%) had secondary education and 61(24.4%) had higher education or were college going. As regard to their occupation, 100 (40%) helping in house hold activities (unpaid workers) and 29 (11.6%) were working as tailors, labourer, maidservants while, only 121 (48.4%) were currently studying.

Among married adolescent girls 23.3 % were married before the age of 15 years and 34.1% were married in the age group of 15 of 17 years. It was observed that out of 47 married girls, 21(44.7%) were pregnant at one or the other time. Among all pregnancies, 19.1% of pregnancies were in the age group <15 years. Out of 21 pregnant women 5 (23.8%) had experienced adverse out come of pregnancy like abortion or still births.

The major reason for early marriage was pressure from elders (53%) and similarly out of 21 ever pregnant women, 57% of pregnancies were due to pressure of elders and 33.55% were due to lack of contraceptive knowledge (Fig.I).

Among married subjects majority, (41.4%) were illiterate and only 23.4% had education qualification upto secondary and above (Fig. II). On the other hand among 203 unmarried females, majority (70.1%) had education qualification of secondary and above and only 6.8% were illiterate. The difference was statistically significant ($p<0.05$).

Out of 250 adolescent girls, 22% had good, 65.2% had fair and 12.8% had poor awareness regarding health problems. Among adolescent girls who had good knowledge of health problems 60% had higher education i.e. PUC and above and only 5.5% had studies upto primary school and none of them was illiterates. On the contrary girls who had poor awareness to health problems, 46.9% were illiterate and only 6.3% had higher education indicating that educational status has a bearing on awareness of the health problems and this was statistically significant ($p<0.001$).

Table I. : Age wise distribution study population

Age group (years)	Number (n=250)	Percent
13-14	28	11.20
14-15	33	13.20
15-16	35	14.00
16-17	33	13.20
17-18	28	11.20
18-19	51	20.40
19-20	42	16.80

Table II. : Age wise distribution of adolesent girls at the time of marriage & first pregnancy.

Age Distribution	Age at Marriage (n=47)	Age at 1st Pregnancy (n=21)
<15	11 (23.4 %)	04 (19.1 %)
15-17	16 (34.1 %)	05 (23.8 %)
17-19	20 (42.5 %)	12 (57.1 %)

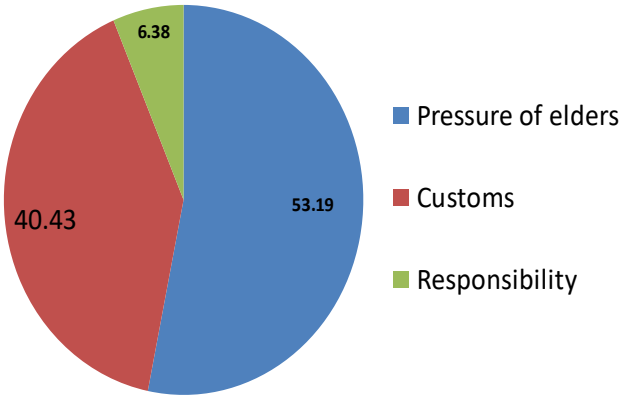

Fig. I: Photograph showing reasons for early marriage.

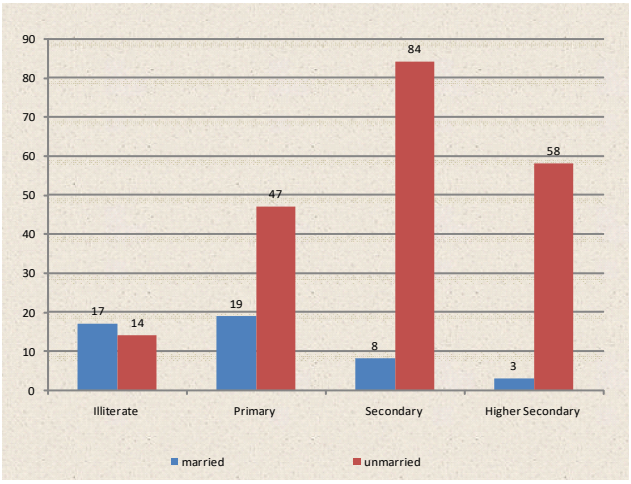

Fig. II: Relation Between Education and Marital Status of adolescent girl.

Discussion:

Age at marriage is an important determinant of the health of young people as well as for future opportunities for education and employment. A large number of girls from poor households are pushed into early marriage, almost immediately after menarche. Out of 4.5 million marriages that takes place in India, three million marriages involve girls in 15-19 years age group (Majumdar & Ganguly, 2000). Current study revealed that mean age of menarche was 13.6± 1.09 years and median age of marriage was 16 years. Similar findings were observed by Singh et al (1999) and Sheila et al (1993), who found mead age of menarche to be 13.06± 0.83 years and 13.6 years respectively.

In the present study married adolescents constituted 18.8% of the total study group. Similarly Nahar et al (1999) observed in their study that 16% of rural and 25% of urban slum adolescent girls were married. These girls were not only married but soon after marriage they became pregnant. The reasons for early marriage given by elders were; difficulty in finding an eligible bridegroom as age advances, preventing premarital affairs and to maintain social prestige. Once married, the girl should prove her fertility and hence early pregnancy.

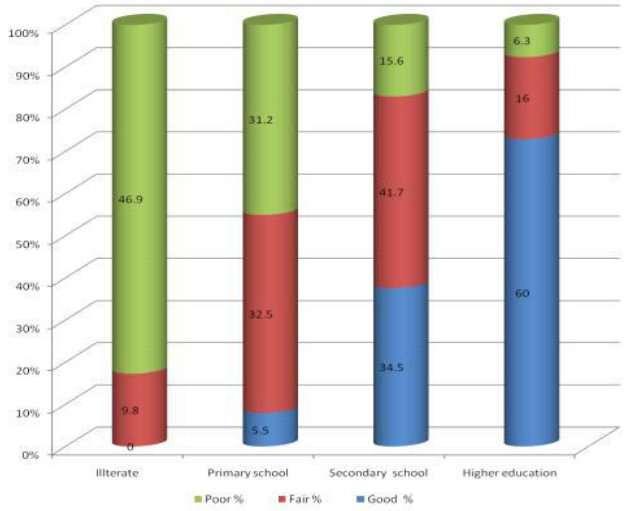

Fig.III: Relation between Education and Awareness Regarding Health Problems among adolescent girl.

In the present study 19% adolescent pregnancies were below the age 15 years; 24% and 57% pregnancies were in the age group of 15-17 and 17-19 years respectively. However, Kushwaha et al (1993) observed 7.8% of adolescent pregnancies were in the maternal age group of <15 followed by 45.5% and 46.7% in the age group of 15-17 and 17-19 years respectively. The education of adolescent girls plays a major role on the marital status and awareness of the health problems. Education needs to be a positive force in building peaceful communities in a rapidly changing world and to make use of it in the service of the community.

Recommendations:

The present study suggests empowering girls yield undeniable returns for everyone in the community. This can be tackled by creating awareness by in community by involving local NGO's or self health groups regarding:

- Impact of education on health
- Adverse effect on health due to early marriage,
- Link between the education and the economic and health benefits especially in the rural India.

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Case Series

Neural Tube Defect Spectrum - Study of Craniorachischisis

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Abstract:

Neural tube defect spectrum (NTD) includes anencephaly, spina bifida, craniorachischisis, inencephaly etc. Four cases of craniorachischisis were studied from a collection of 34 aborted fetuses. There was deficiency of scalp and cranial vault in all the four cases. In one case the defect was extending up to the cervical region, in rest of the three cases, vertebral column defect extended upto thoracic region exposing the spinal cord and spinal nerves. All the cases presented with bulging eyes, broad nose, folded ears, protruded tongue and absent neck. These defects result due to failure of closure of the neural tube during early embryonic life.

Key Words: Anencephaly, neural tube defect, rachischisis, craniorachischisis.

Introduction:

Neural tube defect spectrum includes the disorders related to the non-closure of the neural tube. Several types of NTDs are recognized. Major types of neural tube defects include anencephaly, spina bifida, craniorachischisis, encephalocele, inencephaly (Moore, 2006); anencephaly and spina bifida being the most common. Anencephaly is a developmental defect of the central nervous system in which the brain and cranial vault are grossly malformed. Craniorachischisis is congenital fissure of the skull and vertebral column. This defect results when the neural tube fails to close during the third to fourth weeks of gestation, leading to fetal loss & stillbirth. The present study was carried out to elucidate neural tube defects.

Material and method:

The study was carried out in a collection of 34 aborted fetuses in department of anatomy, People's college of Medical Sciences & Research Centre and Gandhi Medical College, Bhopal. The fetuses were observed for the defect in the cranium, vertebral column and face. Dissection of fetuses was not carried out to find out any other internal anomalies.

Observations:

All the four fetuses showed presence of anencephaly with extension of defect in the vertebral column i. e. craniorachischisis.

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Case 1: In a male fetus of 28 weeks the defect in the cranial vault was observed. The fetus showed absence of a major portion of scalp and cranial vault and the defect was extending to the cervical vertebrae. The brain tissue and spinal cord in the cervical region were exposed to exterior (Fig. I). Below the level of cervical region no defect was observed and vertebral column was covered by normal skin. In this case the nose was broad and ears were folded. The eyes were bulging outward. No abnormality of lips or palate was observed. The trunk was short and shoulders were broad. There was extreme extension of head. No other associated external deformities were observed.

Fig. I: Illustration showing craniorachischisis with extension of defect into the cervical region.

Case 2: Craniorachischis was observed in a 29 week male fetus. There was a defect in the formation of the scalp and vault which was extending upto lower thoracic part of the vertebral column (Fig. II). Brain tissue and spinal cord were covered only by a membranous tissue. Retroflexion of spine was observed. The neck was short, nose was broad and eyes were bulging. Omphalocele was observed (Fig. III). No other abnormalities were seen.

Case 3: A 26 week male fetus presented with a defect in skull vault which extended up to mid thoracic region. The brain tissue and spinal cord were exposed to exterior. Absence of some parts of brain, spinal cord, nerve roots and meninges was seen. Spinal cord and rootlets of spinal nerves were seen exposed to the exterior (Fig. IV). The neck was short, nose was broad, eyes were seen bulged out and ears were folded. The fetus also showed umbilical hernia.

Case 4: A 28 week male fetus showed craniorachischisis. The defect in this case was extending beyond the cranial vault (Fig. V). Brain tissue and spinal cord were exposed to the exterior. The neck was absent and head seem to arise directly from the trunk. The tongue was protruded and ears were folded (Fig. VI). No other external abnormality was observed.

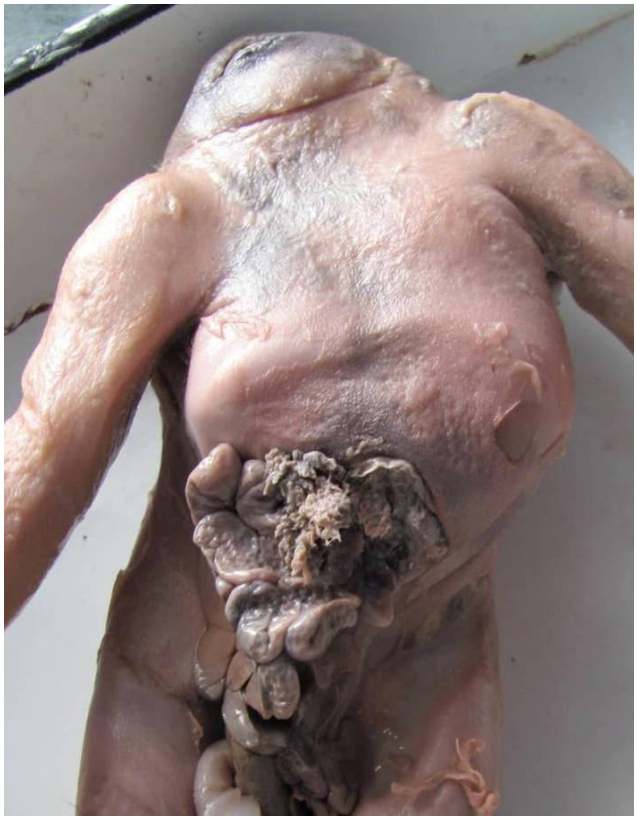

Fig. III: Illustration showing omphalocele.

Fig. II: Illustration showing craniorachischisis with extension of defect into lower thoracic region.

Fig. IV: Illustration showing craniorachischisis with exposed spinal cord and rootlets of spinal nerves.

Fig. V: X ray lateral view of spine showing extension of defect beyond cranial vault in case no. 4.

Fig. VI: Illustration showing folded ears, bulging eyes and protruded tongue.

Discussion:

Neural tube defects (NTDs) are very frequently and encountered congenital abnormalities (Moore & Persaud, 2003). There are several morphological forms of anencephaly. Chourasia (1984) has given simpler classification of anencephaly based on occipito-vertebral and parieto-occipito-vertebral defects. Currently, if the defect is limited to the vault then it is classified as anencephaly and if it extend beyond the cranium then it is known as craniorachischisis.

The neural tube develops and closes during the 3rd & 4th weeks after conception and is normally completed by 28 days post conception (Botto et al, 1999). Craniorachischisis presents with vertebral and cranial vault defect, bulging eyes, broad nose, and folded ears, as seen in the present study. Craniorachischisis can be detected on ultrasound scan at gestational age of 13 weeks (Coskun et al 2009). Anencephaly is often associated with rachischisis and other congenital defects (Kulkarni et al, 1989). Chaurasia in 1984 reported 21 anencephalic fetuses, in all of which defect extended into the vertebral column.

Neural tube defects may also presents with large thymus, small adrenal glands, hypo -plastic lungs, cyclopia, syndactyly, absent radius and thumbs, club foot, imperforate anus, cleft palate, renal and cardiac anomalies. It can also be associated with meningomyelocele, hydrocephalus and Chiari II malformation (Jones, 2006). In the present study, umbilical hernia was seen in one case and an another case it was associated with omphalocele**.** Neural tube defects may be associated with the unbalanced form of a structural chromosomal abnormality in some families (Cunningham et al, 2005). Johnson et al (2004) reported 16 cases of craniorachischisis in a Texas-Mexico border population. Kajaer et al (1994) investigated the axial skeleton related to the notochord in human anencephalic fetuses. Abnormal ossification of cranial base was observed with or without cervical rachischisis.

Fetus with neural tube defects lack functioning cerebrum which rules out the possibility of ever gaining consciousness. They are blind, deaf and unable to feel pain. Some individuals with anencephaly may be born with a rudimentary brainstem, which controls autonomic and regulatory function. Hence, reflex actions such as respiration and responses to sound or touch may occur. Depending on the extent of the skull deficit, descending tracts associated with disrupted structure are absent (Frosch et al, 2004). During pregnancy, polyhydramnios may occur due to lack of the swallowing mechanism.

The cause of NTDs is multifactorial. Exposure to valproic acid and other antimetabolites of folic acid and other toxins like lead etc during critical period i.e. up to 6 weeks after last menstrual period, interfere with normal folate metabolism and increases the likelihood of anencephaly (Cunningham et al, 2005).

Maternal type 1 or pregestational insulin-dependent diabetes mellitus (IDDM), maternal fever in early gestation and amniotic band disruption during pregnancy also increases the risk for anencephaly.

NTDs result from the combined effects of genetic and environmental influences. But the cellular and molecular mechanisms underlying NTDs are very complex, poorly understood and difficult to study in humans. Mouse models are being used in an attempt to identify genes that could be involved in these malformations. . Recent genetic studies of NTDs have identified a number of genes and proteins that play critical roles in neural tube closure. Only two mouse mutations are known to lead to craniorachischisis. The gene for one of these, Loop-tail, has now been identified and sequenced. It has been given the designation Ltap/ Lpp1 and appears to function in floor plate formation (Kapron, 2002). Identifying the genetic factors is critical for these will provide the basis for designing novel preventive strategies and for offering accurate reproductive risks to couples

In the normal human embryo, the neural plate is formed approximately 18th days after fertilization. During the fourth week of development, the neural plate invaginates to form the neural groove. The neural tube is formed due to closure of the neural groove by fusion of neural folds as a process initiated at a single site, and extending bi-directionally, rostrally and caudally, to the rostral and caudal neuropores. Closure completes by day 24 for the cranial end and day 26 for the caudal end. Anencephaly results from failure of neural tube closure at the cranial end of the developing embryo leading to incomplete development of calvaria and brain (Moore & Persaud, 2003; Jones, 2006).

However, recently a hypothesis of "multiple site of neural tube fusion" has been investigated in animal models and in humans. Four sites of neural tube fusion have been identified. Site 1 initiates in the future cervical region between the third and fourth somites at the caudal part of the hindbrain, and progresses both caudally and rostrally. Caudally, it proceeds all the way down to the end of the neural groove until the caudal neuropore. The next two sites of initiation of fusion are located rostral to site 1. A second fusion initiates at the prosencephalon-mesencephalon boundary (Site 2) and extends both rostrally and caudally. This second fusion completely closes the roof of the telencephalon and the metencephalon. A third fusion site (site 3) progresses caudally, and closes the rostral end of the neural plate. Finally, the fourth fusion site (site 4) appears at the caudal end of the neural plate and extends rostrally to meet the fusion extending back from site 1(Detrait et al, 2005). Phenotype of NTD will vary depending on the involvement of the site of fusion.

Van Allen et al (1993) compared the multisite model vs. the traditional single-site model of neural tube closure for the best explanation for NTDs in humans. With the multi-site neural tube closure model majority of NTDs can be explained by failure of fusion of one of the closures or their contiguous neuropores. They hypothesize that anencephaly results from failure of closure at site 2 and craniorachischisis results from failure of closures at sites 2, 4, and 1.

In NTDs the first defect is in the notochord development resulting in failure of the neural folds to fuse in the midline and to make a normal neural tube. The next defect is failure of the mesoderm to develop; mutual induction of all three germ layers in temporally related sequence fails to occur.

Therefore, the calvaria and vertebrae fail to form correctly exposing the neural tissue to further insult. Finally the skull and dural defect permits the neural tissue to be exposed to amniotic fluid thus destroying the neural tissue. Well-preserved brain tissue is usually found until 10 weeks gestation (Becker et al, 2000). Closer contact of the fetus with the uterine wall usually starts from about 10 weeks, when substantial portions of the amnion are fused with the chorion. The fetal brain is then exposed to increasing mechanical trauma, resulting in progressive "rubbing off" of the brain tissue. The exposed neural tissue undergoes secondary degenerative changes that convert it into a mass of vascular connective tissue, the area cerebrovasculosa, which is a flattened remnant of degenerated brain tissue admixed with choroid plexuses, ependyma and mesothelial cells. The exposed base of the skull is covered only by a vascular membrane (Wilkins-Haug & Freedman, 1991; Bronshtein & Ornoy, 1991; Timor-Tritsch et al, 1996; Powers & Horoupian, 1996; Frosch et al, 2004; Crowley, 1999).

This defect can be diagnosed during Alpha-fetoprotein (AFP) screening. Fetal ultrasound can also be useful for screening of neural tube defects (Baker, 2006). The recurrence risk is 1.9% for parents who had one affected child. Folic acid supplementation has been shown to be an effective means of lowering recurrence risks for future pregnancies (Jones, 2006).

The prognosis in severe form of neural tube

defects is exceptionally poor; death of the neonate is unavoidable. There is no cure or standard treatment for craniorachischisis. Therefore, pregnancy should be terminated if diagnosed early.

Conclusion:

NTDs can be prevented by taking folic acid supplementation during reproductive age. Screening tests like AFP and USG can diagnose the condition early and termination can be decided earliest possible. Parents of babies with NTDs should be educated about preventive measures for future pregnancies. Genetic counseling may be helpful in this respect.

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Case Series

Use of Nasolabial Flap in the Management of Oral Submucous Fibrosis – A Clinical Study

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Abstract:

Oral submucous fibrosis is a chronic debilitating disease associated with restricted mouth opening and poor oral hygiene. The treatment aims at good release of fibrosis and to provide long term results in terms of mouth opening. Various local grafts have been used to cover the buccal mucosal defects after the fibrotic bands are released in oral submucous fibrosis. Successful use of inferiorly based nasolabial flaps in the management of oral submucous fibrosis is projected.

A total of 10 histologically proven cases of oral submucous fibrosis having a mouth opening of less than 20 mm were surgically treated .The procedure involved (1) bilateral release of fibrotic bands (2) measurement of intra-operative interincisal distance (greater than 35 mm achieved in all patients after release of bands) (3) covering the defects with inferiorly based nasolabial flap. All patients had post-operative physiotherapy, and were followed up regularly for one year. All flaps healed without evidence of infection, dehiscence, or necrosis. Results were assessed by comparing the pre-operative & pos-toperative maximum mouth opening.

The inferiorly based nasolabial "islanded" flaps provide reliable coverage of defects of the buccal mucosa and improves mouth opening .

Key Words: Oral submucous fibrosis (OSMF), Nasolabial flap, axial pattern flap.

Introduction:

Oral submucous fibrosis is characterized by blanching and stiffness of the oral mucosa, which causes progressive limitation of mouth opening and intolerance to hot and spicy food. It is more prevalent in Indian subcontinent and is identified as an important premalignant condition (Paissat, 1981, Gupta & Sharma, 1988). Its precancerous nature was first described by Paymaster in his study of 650 Indian patients and he found that one third of patients had onset of slowly growing squamous cell carcinoma (Paymaster, 1956).

Medical treatment is indicated at an early stage but mostly patients present with moderate to severe form of diseaseb (Lee et al, 2006). Surgical treatment is indicated at this late and irreversible stage. The procedure consists of release of fibrous bands followed by resurfacing the raw areas with skin graft, fresh amnion, collagen, or local flaps (Canniff et al,1986).

The nasolabial flap is typically classified as an axial pattern flap based on angular artery. It can be based superiorly or inferiorly. Surgical descriptions about nasolabial flap began as early as 1830 when Dieffenbach used superiorly based nasolabial flaps to reconstruct nasal alae. In 1864, Von Langenbeck used the nasolabial flap to reconstruct the nose (Schmidt & Dierks, 2003). Fifty-seven years later, Esser (1921) described the use of the inferiorly based nasolabial flap to close palatal fistulae (Esser, 1921). Inferiorly based nasolabial flap is a reliable, economical option for the management of oral submucous fibrosis (Borle et al, 2009).

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Material and Methods:

A total of 10 patients of oral submucous fibrosis were admitted and surgically treated in our hospital with due permission of the ethical committee. All patients signed an informed consent form before surgery. All these patients had advanced oral submucous fibrosis with interincisal distance not more than 20 mm. Patient's age, sex, etiology, history of gutkha/ tobacco chewing, and preoperative mouth opening were documented. All the cases were histopathologically proven. Patients were followed regularly for one year and maximum interincisal distance was measured.

Surgical Technique:

The operation was performed under general anesthesia with nasal intubation. After opening the mouth, the buccal mucosa was incised transversely from just behind the commissure of the oral cavity extending posteriorly depending upon the location of

the fibrotic bands (Fig. I). Mouth opening was checked & intraoperative interincisal distance was more than 35 mm in all patients immediately after release of bands. The maxillary and mandibular third molars were extracted. Nasolabial flaps from the tip of nasolabial fold to corner of mouth were marked & bilaterally raised in the plane of the superficial musculoaponeurotic system (Fig. II & III).

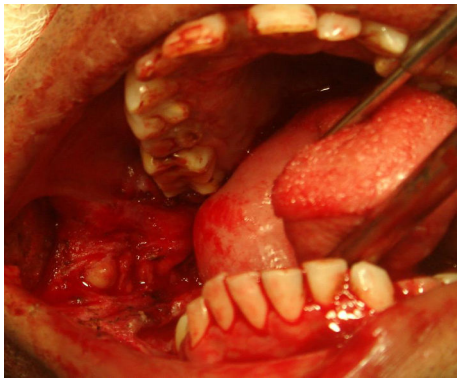

Fig. I: Photograph showing release of fibrotic bands.

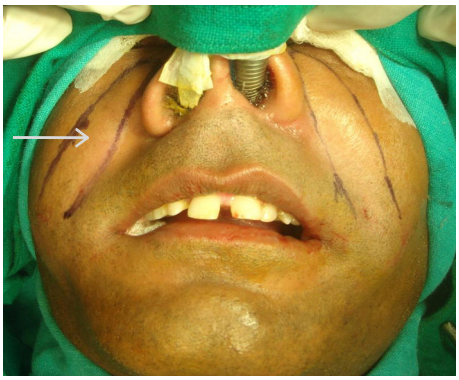

Fig.II: Photograph showing surgical marking of Nasolabial flap.

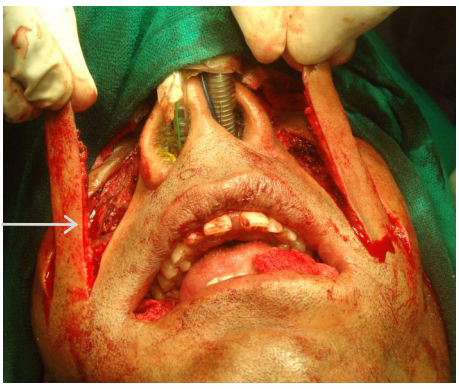

Fig. III: Photograph showing harvesting of nasolabial flap.

The flap was transposed intraorally through a small transbuccal tunnel near the commisure of the mouth, with no tension and the caudal base of the inferiorly based nasolabial flap was deepithelized in a triangular fashion (Fig. IV). The area of deepithelialization is determined by the required length of the transbuccal

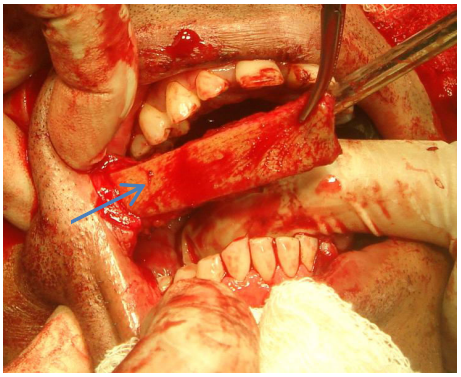

Fig. IV: Photograph showing transbuccal tunnel.

tunnel .This maneuver is the key to a 1-stage procedure with inset of flap (Fig. V). The extraoral defect was closed primarily in layers after undermining skin

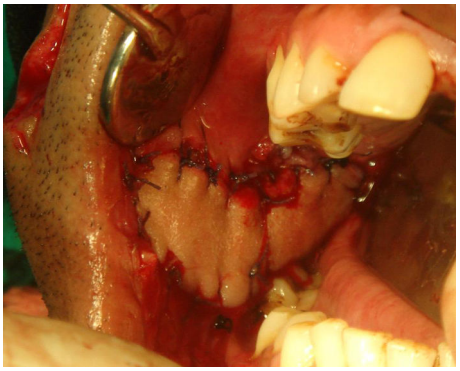

Fig. V : Photograph showing Inset of nasolabial flap.

in subcutaneous plane to prevent tension across the suture line. Physiotherapy was started from the 5th postoperative day & patients were instructed to continue the physiotherapy themselves for upto 6 months to prevent relapse. Patients were followed up at regular intervals.

Results :

Adequate mouth opening was achieved & maintained with minimum intraorally as well as extraorally scarring (Fig VI a & b) and Table I. Healing was excellent without evidence of infection, dehiscence or necrosis.

Discussion :

A mucosal graft is the best treatment for oral submucous fibrosis, as it is an ideal graft to cover the oral mucosa, but is limited by the quantity of oral mucosal available for grafting. Split-skin grafting has been tried but it has a high failure rate as fibrotic areas have less vascular supply. Skin is not suitable for grafting in elderly people due to atrophy and inelasticity (Kakar et al, 1985).

Table I: Showing comparison of pre & post-operative interincisal opening

Patient Nos.	Age in yrs	Sex	Pre-operative Interincisal mouth opening	Post-operative (1year) Interincisal mouth opening
1	32	M	19.0 mm	35.2 mm
2	28	F	20.0 mm	36.0 mm
3	35	M	18.0 mm	36.5 mm
4	29	M	17.5 mm	35.5 mm
5	31	M	16.5 mm	37.0 mm
6	36	F	17.6 mm	38.0 mm
7	27	M	19.2 mm	37.5 mm
8	37	M	18.5 mm	35.2 mm
9	29	M	17.0 mm	36.0 mm
10	40	M	16.5 mm	35.4 mm

(a) (b)

Fig. VI : Photograph showing adequate mouth opening and adaptation of nasolabial flap after 1 year.

Tongue flaps are bulky and when used bilaterally cause disarticulation, dysphagia and increased chances of aspiration. In addition, the tongue is involved with the disease process in 38% cases (Ramadas et al, 2005). The use of bilateral, small, bipaddled radial forearm flaps for reconstruction of bilateral buccal defects requires two flaps with two microsurgeries. The procedure is more time consuming and technically demanding. Island palatal flaps again have limitation that they fail to reach posteriorly (Lee, 2007). Buccal fat pad may also be used to cover the defects after excision of the fibrous bands. Harvesting of buccal pad fat is easy but the anterior reach of the flap is often inadequate and can not be used for larger defects (Paissat,1981) .

We used inferiorly based Nasolabial flaps for the reconstruction of mucosal defects after excision of fibrous bands. The advantages of nasolabial flap include its close proximity to defect, easy closure of donor site & a well camouflaged scar. The technique is easy to master and defects as l arge as 6 to 7 cm can be closed. The postoperative extraoral scars are hidden in the nasolabial fold. Minor complications of the nasolabial flap include loss of the nasomaxillary crease and the creation of an edematous and bulky flap. A periosteal suture can be used to recreate the crease. By trimming all of the fat from the flap, the bulkiness can be reduced

Conclusion:

Despite these reports of complications, the inferiorly based nasolabial flap has proven to be reliable for the reconstruction of oral defects. All flaps healed without evidence of infection, dehiscence, or necrosis and results were excellent.

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Case Report

Juvenile Psammomatoid Ossifying Fibroma – A Case Report

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Abstract:

Juvenile ossifying fibroma (JOF) is a rare fibro-osseous neoplasm in young children. JOF is defined as a variant of the ossifying fibroma, and latter includes juvenile psammomatoid ossifying fibroma (JPOF) and juvenile trabecular ossifying fibroma (JTOF). Both variants involve the craniofacial bones with the trabecular variant being more common in the jaws and the psammomatoid variant being more common in the paranasal sinuses. This lesion is locally aggressive and spreads quickly. As it has a very high recurrence rate, complete excision is essential. A case of large JPOF involving right maxilla and other cranial bones in a 12 year old female patient with clinical, radiographic and histopathological features are presented. Surgical management and follow up is also emphasized.

Key Words: Fibroma, Ossifying; Juvenile.

Introduction:

The juvenile ossifying fibroma is also known as "Aggressive ossifying fibroma or Active ossifying fibroma" (Neville et al, 2002). It has been distinguished from the larger group of ossifying fibroma on the basis of age of occurrence, most common site of involvement and clinical behavior (Granados et al, 2002). Most of them affect extra-gnathic bones; some affect maxilla and craniofacial bones but rarely mandible (Lawton et al, 2002). Juvenile ossifying fibroma was first described by Benjamins in 1938 as "osteoid fibroma with atypical calcification." (Khoury et al, 2002). Later on in 1952 Johnson coined the term "juvenile active ossifying fibroma" (Neville et. al 2002). Histologically, It has two distinct microscopic patterns; trabecular and psammomatoid. It is an aggressive lesion mimicking malignancy such as osteosarcoma. So, it is important to accurately recognize JOF for making the diagnosis and managing the disease (Park et al, 2007).

Case report:

A 12 year old girl reported to department of Oral Medicine & Radiology, Guru Nanak Dev Dental College & Research Institute, Sunam with complaint of swelling on right side of face for last 3 years. History revealed a small painless swelling first appeared at the age of 6 years which gradually increased in size within the span of 2 years. She underwent surgery for that and remained asymptomatic for one year. Swelling recurred again at same site and gradually increased within the span of 3 years to attain the present size. There was history of difficulty in breathing, swallowing and watering from right eye. Extraoral examination (Fig. I & II) revealed gross facial asymmetry on the right middle 1/3rd of face. A solitary, roughly oval in shape and well defined swelling measuring 8 × 9 cm in dimension was noticed which was extending superiorly from infraorbital ridge to inferiorly about 2cm above the lower border of mandible, medially starting from left ala of nose crossing the mid sagittal line and extending laterally 3cm in front of right tragus. Overlying skin was stretched with focal areas of hyperpigmentation.

Fig.I: Extraoral photograph (frontal view) showing facial asymmetry due to swelling

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Fig.II: Extraoral photograph (lateral view) showing swelling in right middle 1/3 of face.

There was deviation of nose towards left side, right eye was displaced upward and laterally, drooping of right commissure of mouth with obliteration of inferior orbital and nasolabial fold. On palpation, swelling was non tender, hard in consistency with egg shell crackling was felt. There was no local rise in temperature.

Intraoral examination revealed a solitary well-defined swelling obliterating the right buccal vestibule involving major portion of the hard palate except on left lateral margin (Fig. III). The swelling was 2 mm away from palatal gingival margin of maxillary anterior teeth and extending posteriorly up to the junction of hard and soft palate. Laterally extending from right buccal vestibule, crossing the alveolar ridge and midpalatal raphae, and extending 1.5 cm in front of palate-gingival margin of left maxillary posterior teeth medially. Overlying mucosa was stretched. Swelling was non-tender and hard in consistency with egg-shell crackling in the center. Hard tissue examination revealed patient was in mixed dentition stage. Teeth 12 and 16 were clinically missing and multiple retained primary teeth were present.

Provisional diagnosis of Tumour of Right Maxilla with differential diagnosis of Fibrous dysplasia, Cementoossifying fibroma, Juvenile ossifying fibroma, Ameloblastoma, Odontogenic keratocyst, Osteo-sarcoma and peripheral giant cell granuloma were

Fig. III: Intraoral photograph showing palatal swelling.

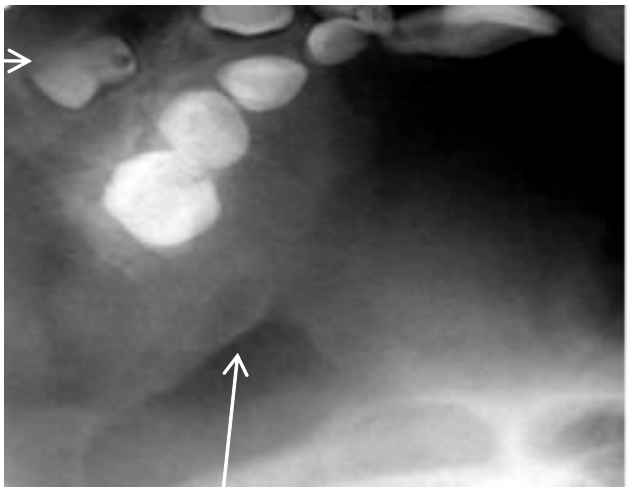

Fig. IV: Maxillary occlusal radiograph showing cortical expansion with radiopaque internal mass & buccal displacement of 12,13,14 (arrows).

considered. All teeth in the vicinity of lesion were vital. Haematological and serological investigations were within normal limits except elevated alkaline phosphatase level (244 IU/l).

Maxillary occlusal cross-sectional radiograph (Fig.IV) revealed dense homogeneous well demarcated radiopacity with focal areas of radiolucency on right side with expansion of buccal cortex and palatal bone extending from right premaxilla to beyond the right maxillary tuberosity. Teeth 12,13, 14 were buccally placed.

Panoramic radiograph (Fig. V) revealed that on right side homogeneous radiopacity involving maxilla encroaching maxillary sinus, zygomatic bone, nasal cavity, pterygoid plates and downward slanting of occlusal plane with drifting of maxillary teeth of right side.

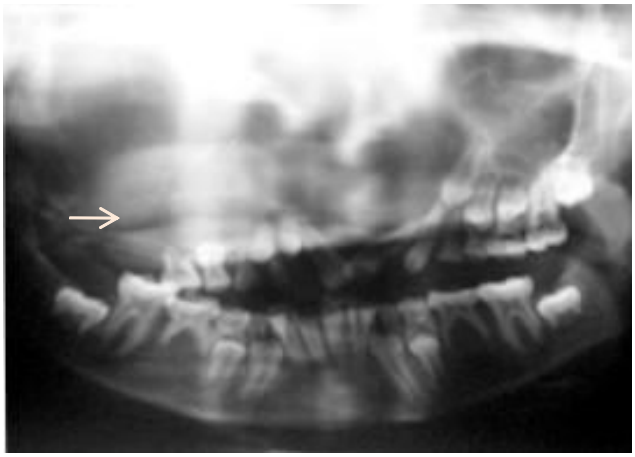

Fig.V: Panoramic radiograph showing diffuse radiopacity at right maxilla obliterating maxillary sinus (arrow).

Paranasal sinus view (Fig. VI) also revealed homogeneous radiopacity medially crossing midline, superiorly extending about 0.5 cm above right infra orbital rim and Inferiorly approaching the alveolar process of maxilla.

Fig. VI: Para-nasal sinus view showing large radiopaque mass obliterating maxillary sinus & surrounding areas.

CT scan (Fig.VII & VIII) showed grossly expanded right maxillary sinus with distorted contours and marked thinning of all walls and expansile mixed attenuation mass with well demarcated outline filling the right maxillary sinus, frontal sinus, ethmoidal sinus, right nasal cavity medially crosses midline, superiorly extending toward inferior orbital ridge, Inferiorly encroaching the palate on right side and extending toward the sphenoid sinus. Incisional biopsy of the lesion was taken and sent for histopathological examination (Fig. XI) which revealed evidence of cellular proliferation of bland appearing spindled cells of apparent fibroblastic nature with prominent associated cementum-like calcifications (psammoma bodies).

Final diagnosis of juvenile psammomatoid ossifying fibroma was made. Surgical excision of lesion was carried out. Patient was recalled regularly every 3 months interval. No evidence of recurrence was seen even after one year. (Fig. X)

Fig. VII: CT Coronal view showing expansile mixed attenuation mass with grossly expanded maxillary sinus (arrow).

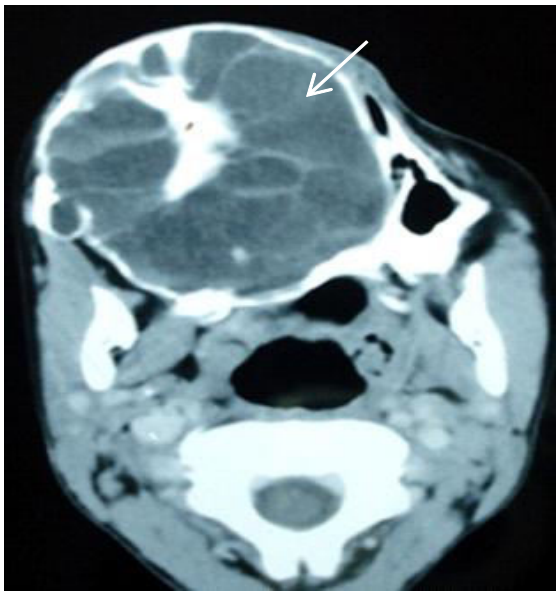

Fig. VIII: CT Axial view showing expansile mixed attenuation mass (arrow).

Discussion

The fibro-osseous lesions are those in which the normal bone architecture is replaced by fibroblasts and collagen fibres that contain various amounts of

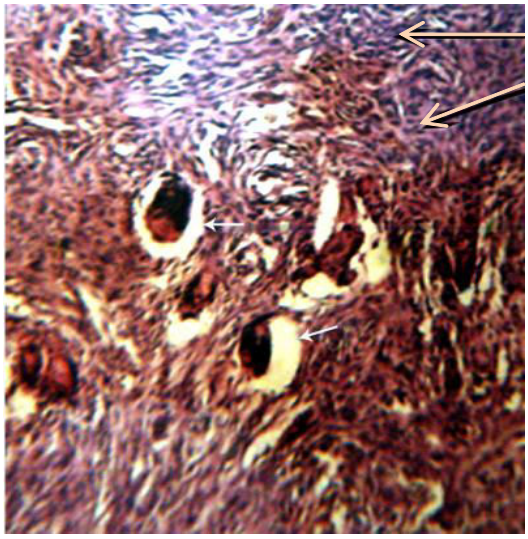

Fig. IX : Photo micrograph showing proliferation of fibroblasts in a densly arranged stroma (arrows-orange) with prominent associated cementum-like calcifications i.e. psammoma bodies (arrows), (40X, H&E).

Fig. X: Post-surgical photograph showing significant recovery of facial esthetics.

mineralized material. Juvenile psammomatoid ossifying fibroma is one of the types of fibro-osseous lesion. The main characteristics are: patient under 15 years of age, the location of the tumour, the radiologic pattern and tendency to recur. The orbit and paranasal sinuses are the most common site, accounting for over 72% of reported cases, followed by the calvarium 11%, maxilla 10%, and mandible 7%. In reviews published by Hamner et al and Slootweg et al. (Saiz-Pardo-Pinos et al, 2004), the mean age of onset was 11.5 and 11.8 years. Most cases of maxillary JOF are asymptomatic. In large lesion, the clinical manifestations are swelling of the maxilla, exophthalmos, bulbar displacement nasal obstruction, root resorption and displacement of teeth in the tooth-bearing region. The radiologic features show varying degrees of radiodensity. On CT, aggressively progressing ossifying fibroma appears as expansile mass covered by a thick shell of bone density with a multiloculated internal appearance and a content of varying density (Sarwar et al, 2008). Histologically, Psammomatoid type of JOF shows highly cellular fibrous stroma often with whorled pattern containing closely packed spherical ossicles resembling psammoma bodies. The treatment for JOF is conservative excision or curettage; some lesions may necessitate more aggressive management. Because the recurrence rate for JOF ranges from 30% to 58%, continued follow-up is essential. Despite the aggressive nature of the lesion and high rate of recurrence, malignant transformation to sarcoma has not been reported (Sun et al, 2007).

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Case Report

Uncommon Presentation of Common Disease

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Abstract:

Tuberculosis is a chronic, granulomatous disease. Primary lesion usually occurs in the lung. Extra pulmonary infection commonly involves head, neck and abdomen. In the absence of typical features of tuberculosis, tuberculous cellulitis mimicking oral infection may pose a challenge for diagnosis. In an attempt to highlight an uncommon presentation, we document a case of extra pulmonary tuberculosis in the parotid gland (tuberculous parotitis), without evidence of pulmonary tuberculosis and HIV.

A 30 year old female from low socio-economic status reported with pain in front of the left ear and difficulty in opening her mouth. Swelling was present on left side of the face without evidence of intraoral focus of infection. She was diagnosed to be having tuberculosis of parotid gland after fine needle aspiration cytology (FNAC), Ultrasonography (USG) and histopathological examination and was treated medically and surgically.

Key Words: Tuberculosis, Parotid gland, Tuberculous Parotitis.

Introduction:

Tuberculosis is a chronic, granulomatous disease commonly affecting the lungs. It is one of the leading infectious diseases in the world. It is one of the oldest diseases and is in fact as old as the mankind itself. It still remains as an uneradicated disease (Praveen et al, 2007). India accounts for nearly one-third of global burden of tuberculosis (Park, 2005).

The patient of pulmonary tuberculosis usually presents with fever, cough, night sweats, anorexia, weight loss, haemoptysis and breathlessness (Haslett el al, 2002). HIV infection is considered as the most prominent risk factor in acquiring active tuberculosis. Approximately 8% of persons with tuberculosis are co-infected with HIV. Excluding tuberculous lymphadenitis of the neck, which is present in about 10% of patients suffering from extra pulmonary tuberculosis, disease occurrence in the head and neck region is seen in about 1% of patients (Rinaggio, 2003).

Tuberculous parotitis was first described in 1981 by Kuruvilla. Tuberculous parotitis with pulmonary infection is seen more commonly, but primary type of isolated parotid tuberculosis is seen very rarely (Selcuk et al, 2006).

Case Presentation:

A 30 year old housewife from low socio-economic status, reported complaining of severe pain in front of left ear for two months and swelling with difficulty in opening the mouth for last 3 weeks (Fig.I). Her family history and past medical and dental history were not significant. She was pale, moderately built and moderately nourished.

Fig. I: Showing swelling on left side of face.

An irregular, diffuse swelling was noted in pre-auricular area on the left side, measuring approximately 3 x 5 cm. It was extending from pinna to the outer canthus of the eye and down upto the lower border of the mandible. It was tender and soft to firm in consistency. Regional lymph nodes were soft, mobile and tender. Movements of temporomandibular joint were less pronounced on left side; mouth opening was 17 mm with deviation towards left side (Fig. II). Intra- oral examination revealed discoloured lateral

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incisor in left upper quadrant which was non vital on electric pulp testing. Ellis class I fracture in relation to right lower central and lateral incisor was observed and teeth were vital on electric pulp testing.

Provisional diagnosis of chronic parotitis of left side and chronic irreversible pulpitis of upper left lateral incisor was made. The differential diagnosis included adenoma of parotid gland, adenoma with malignant changes and submassetric space infection. Odontogenic source of infection causing the swelling was ruled out by the absence of third molar and any active carious lesions. Periapical abscess was present in relation with upper left lateral incisor (Fig. III).

Fig. II: Showing reduced mouth opening.

Fig. III: Panoramic view showing absence of third molars and any other source of odontogenic infection. It also shows no fracture or evidence of any temporomandibular joint pathology.

Buccal mucosa of left side was dried and sterile gutta-percha was inserted in the left Stenson's duct and sample of saliva was collected for culture and sensitivity. Patient was placed on antibiotic therapy (Amoxicillin 500mg and Metronidazole 400 mg three

Fig. IV: Ultrasonography of parotid gland showing irregular hypo echoic areas with ill-defined margins. The collection was abutting superficial lobe of parotid. (arrow) showing intraparotid abscess.

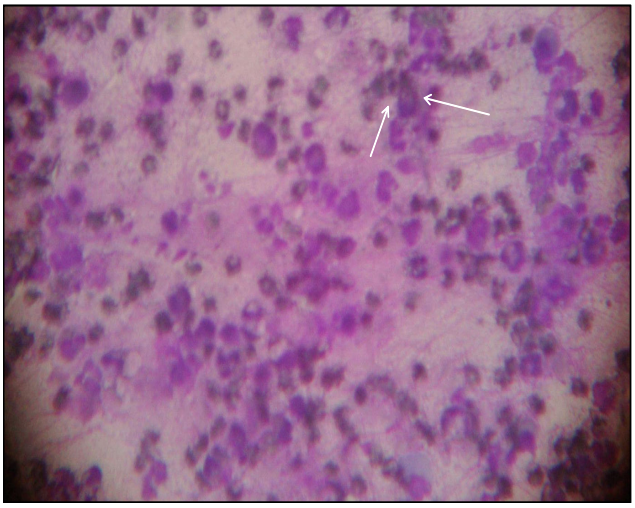

Fig. V: Fine needle aspiration cytology showing few epitheloid granulomas with langhans cells (arrows).

times a day) along with anti-inflammatory analgesics.

Culture of saliva showed pseudomonas growth. Ultrasonography (USG) of the left parotid gland showed irregular hypo-echoic areas with ill defined margins and heterogeneous internal contents. Findings were suggestive of parotid abscess (Fig. IV).

Fine needle aspiration cytology (FNAC) of left parotid gland revealed granulomatous lesion with epitheloid and Langhans giant cells (Fig. V), which was consistent with tubercular granulomatous lesion. The diagnosis was confirmed by biopsy of the tissue taken from the same site (Fig. VI).

Mantoux test was strongly positive. Saliva was negative for AFB. X- ray chest was normal (Fig. VII). Blood investigations showed Hb 9 gm% and ESR 45

mm after Ist hour. Patient was non-reactive to ELISA test.

Patient was put on antitubercular regimen as per the Revised National Tuberculosis Control Programme (RNTCP) criteria Category III.

Fig. VI: Histopathological examination showing presence of Langhans cells (arrow).

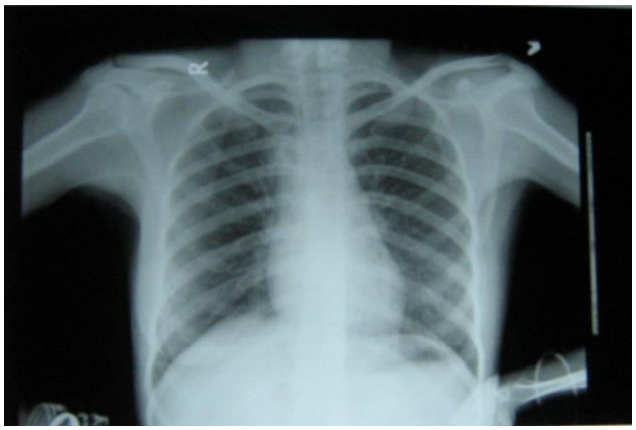

Fig. VII: Chest X-ray showing no abnormalities.

Fig. VIII: Showing reduced swelling after 21 days of antitubercular regimen.

Follow up after 21 days showed redution in swelling with improvement in mouth opening up to 20 mm (Fig. VIII & IX). Deviation of mouth was noted towards left side on opening. Patient was further investigated and treated for TMJ abnormality and endodontic treatment was carried out for upper left lateral incisor.

Fig. IX: Mouth opening 20mm after 21 days

Discussion:

Extrapulmonary forms of tuberculosis account for approximately 20% of overall active tuberculosis, but the salivary glands appear to be rarely affected. This may be due to the inhibitory effect of saliva on mycobacteria (Birkent et al, 2008). Tuberculosis of the parotid gland is uncommon and only 100 cases being described in the literature in immunocompetent patients (Rangel et al, 2005). Tuberculous parotitis occurs in 2.5% - 10% of parotid gland lesion even in countries where the disease is endemic such as India (Birkent et al, 2008).

Tuberculosis of parotid glands may be clinically misdiagnosed as parotitis, Warthins tumours, mixed tumours and sometimes malignant tumours. The existence of a known parotid lesion, with or without enlarged cervical lymph nodes and with no history or other evidence of tuberculosis is clinically suggestive of malignancy. Patients, therefore, may be referred for surgical intervention, which apparently carries risks of destruction of the parotid gland with fistula formation or facial palsy (Singh & Maharaj, 1992).

Histo-pathologically there are two types of Granulomatous parotitis: (i) localised disease with a solid mass corresponding to tuberculosis in the lymph node of the parotid, (ii) diffuse disease involving parenchyma with nodules of irregular size and consistency (Birkent et al, 2007). The pathogenesis of

parotid tuberculosis remains unclear. Involvement of the parotid gland and lymph nodes may occur in two ways: (i) a focus of mycobacterial infection in the oral cavity liberates the mycobacterium which ascends into the salivary gland via its duct or passes to its associated lymph nodes via lymphatic vessels. (ii) second pathway involves hematogenous or lymphatic spread from a distant primary lung focus.

It most commonly presents as a localized mass, resulting from infection of intracapsular or pericapsular lymph nodes. It may also present as an acute sialadenitis with diffuse glandular enlargement. In this form the involvement is in the parenchyma of the salivary gland. It may also present as a periauricular fistula or as an abscess (Suleiman, 2001). Another mode of involvement as stated by Carmody is from infected molar tooth (Bakshi et al, 2009).

The most commonly implicated agent is mycobacterium bovis. Atypical mycobacterium rarely infects the parotid (Bakshi et al, 2009).

Primary tuberculosis of parotid gland presents in two forms: first acute inflammatory lesion mimicking sialadenitis which is more common, consisting of small and large abscesses, the parotid tissue is edematous, friable and indurated at places, second presentation is chronic tuberculous lesion which is circumscribed. The lesion presents as gradually increasing mass over months to years with no symptoms apart from swelling. On clinical examination it is impossible to distinguish them from parotid neoplasm (Bakshi et al, 2009).

In the present case the asymptomatic swelling was of long duration, but the appearance of acute pain in the same region made patient seek medical assistance.

HIV infection is considered as the most prominent risk factor in acquiring active tuberculosis and tuberculosis involving the parotid gland (Rinaggio, 2003).

Unusually oral manifestations may be the first manifestation of the disease. The case presented here is rare as it windows the parotid gland without HIV, active pulmonary tuberculosis and without draining sinus or fistula.

Acknowledgements:

Dr. Sanjay Tandon and Dr. M.S. Saini, Deptartment of tuberculosis and chest diseases, Dr. Swati Naik, Department of Radiology. People's college of medical sciences and research centre, Bhopal and Dr. Rashmi Nichalani. Pathologist of Bhopal.

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Case Report

Treatment of Skeletal Class II Malocclusion Using The "Forsus" Appliance: A Case Report

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Abstract:

Fixed functional appliances are valuable tools introduced to assist in the correction of skeletal class II malocclusions at the deceleration stage of growth for achieving stable results. The most commonly used such appliances are the Herbst appliance and the Jasper jumper. The recent advance in the field of fixed functional appliance is the Forsus appliance. We are reporting a 16 year old patient with a skeletal class II malocclusion treated using the Forsus appliance. The appliance was worn for 4 months after the initial alignment with fixed mechanotherapy (MBT O22). The mandible was brought forward to a class I skeletal and dental relationship by the end of this treatment.

Key Words: Fixed functional appliance, Forsus, Class II malocclusion, Growth modulation.

Introduction:

Treatment of class II malocclusion has always been an enigma to the orthodontic faternity. Skeletal class II malocclusion has been treated by various forms of functional appliances to achieve better esthetics and functional harmony (Pancherz, 1979). Correction of skeletal class II malocclusion by growth modulation during active growth can be achieved using various myofunctional appliances like activator, Frankel's regulator and the twin block (David et al, 2009; Beckwith et al, 1999). Treatment of class II malocclusion during deceleration stages of growth has been a challenge and a bone of contention for various schools of thoughts (Adams et al, 1972). Few orthodontists have proven that skeletal correction can be achieved even during deceleration phase of growth by using certain fixed functional appliances (Gianelly et al, 1984).

The Herbst appliance is an upper and lower fixed appliance linked by a telescopic mechanism. This mechanism holds the mandible forward in a protruded position throughout treatment to modify mandibular growth. The appliance allows opening and closing movements of the mandible, and some lateral movement. Use of Herbst appliance gives remarkable results as compared to other methods of Class II correction. The Herbst appliance and many of the inter-arch appliances used to correct Class II malocclusions suffer from problem of breakage of the constituent parts. The Herbst appliance is also expensive and difficult to make. Considering the disadvantages of Herbst appliance, in the present study Forsus appliance was used. Here, we are presenting a case of a class II skeletal malocclusion treated by using the Forsus appliance.

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Case Report:

A 16 years old boy reported to department of Orthodontics with the chief complain of irregular teeth. Clinical examination showed Angle's class II molar as well as canine relationship with increased overjet and overbite. Maxillary arch was constricted showing mesially inclined peg laterals with mild imbrications in the mandibular arch and cross bite on right 1st pre

Fig. I: Pre-treatment cephalogram.

Fig. II: Post-treatment cephalogram.

molar region. Mild hypo-mineralization of right upper and lower molars was seen (Fig. IV). Profile was convex with 100% incisal exposure. Cephalometric analysis revealed skeletal class II malocclusion with retrognathic mandible. Orthopentogram (OPG) revealed erupting 3rd molar in all 4 quadrants. On radiographic examination of cervical vertebrae, 65% of adolescence growth was still expected according to Hassel & Farman (1995) system of skeletal maturation (Fig I& II).

a) Frontal view

b) Frontal view with smile

c) Lateral view

Fig. III: Extra-oral pre-treatment photographs.

Treatment Plan:

The Forsus fixed functional appliance was the appliance of choice to be used along with MBT O22 mechanics. The anchorage was reinforced by using

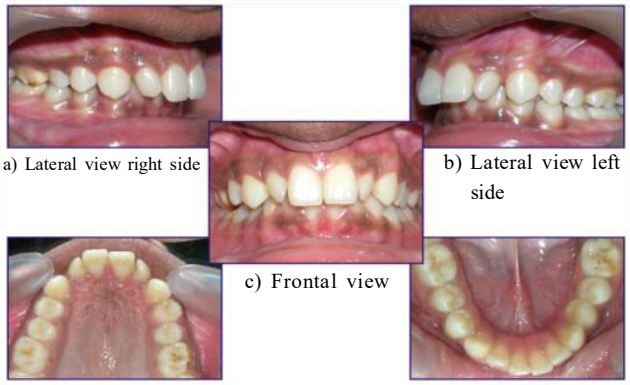


Fig. IV: Intra-oral pre-treatment photographs.

trans-palatal arch in the maxillary arch and the arch wire was cinched back in the mandibular arch. For initial 2 months, alignment was done with 0.016 NiTi wires in upper and lower arches. This was followed by 0.017 x 0.025 rectangular NiTi wires and then by 0.019 x 0.025 stainless steel wire in the lower arch and 0.017 x 0.025 stainless steel wire in the upper arch as a main arch wires. Forsus appliance was then used actively for 4 months. During this phase, the appliance was activated every 4 weeks by distallising the stopper in the mandibular arch wire by 1mm (Fig. V).

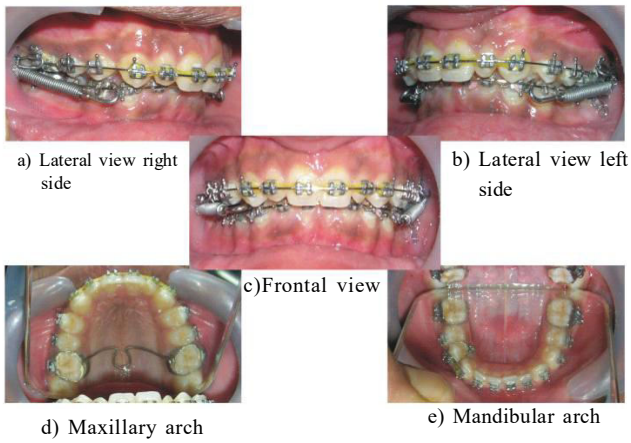


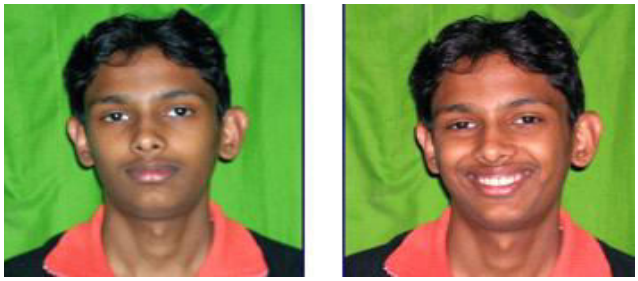
Fig. V: Mid-treatment photographs.

Superimposition of pre and post-treatment cephalograms showed an increase in the length of mandible with increase in lower facial height, correction of overjet and soft tissue competency.

Result & Discussion:

Treatment of class II skeletal malocclusion has always been a challenge for an orthodontist, especially in the deceleration stages of growth (Nelson et al, 2000).

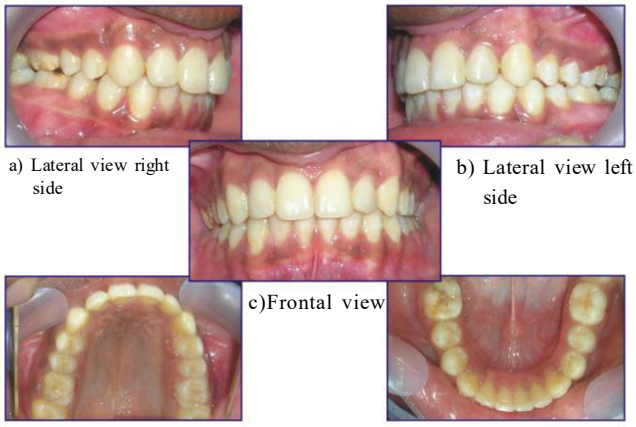
Over the years many fixed functional appliances have been used by orthodontists and only a few have shown well acceptance and favourable results on the patient (Cope et al, 1994; Karacay et al, 2006). Forsus appliance which has been recently introduced, is well accepted showing stable results (Heinig & Goz, 2001).



a) Frontal view b) Frontal view with smile

c) Lateral view

Fig. VI: Extra-oral post-treatment photographs.



a) Lateral view right side b) Lateral view left side c)Frontal view d) Maxillary arch e) Mandibular arch

Fig. VII: Intra-oral post-treatment photographs.

The result achieved after using Forsus appliance in the present case are shown in table I a, I b, I c & II.

The post-treatment measurements showed favourable sagittal skeletal changes:Sella-Nasion-A Point (SNA) angle remained the same, increase in Sella Nasion-B Point (SNB) angle from 77^0 to 79^0, 3^0 reduction in A Point-Nasion-B Point (ANB) angle & Wit's reduction of 2 mm (Table I a). At the end of treatment vertical skeletal changes indicated increase in lower facial height (Table I b). Schwarz mandibular length increased only by 2 mm, while there was no change in maxillary length. Harvold length increased by 1mm in maxilla and 5mm in mandible (Table I c) was noticed. The dento-alveolar changes showed that maxillary incisors were retracted significantly by 3.5mm linear and 7^0 angular while mandibular incisors were proclined by 1mm linear and 2^0 angular (Table II). The soft tissue improvement was seen with a trend towards Orthognathic profile (Fig. VI & VII).

The similar results were achieved by Graham et al (2008) in their study. They concluded that the Forsus is an acceptable substitute for Class II elastics for patients who appear to be noncompliant. They further added that the greater forward displacement of the mandible is the predominant factor contributing to success when treating Class II patients with either Class II elastics or the Forsus appliance.

Table I a: Showing skeletal changes in sagittal plane.

	Pre-treatment	Post-treatment
SNA	82^0	82^0
SNB	77^0	79^0
ANB	5^0	2^0
WITS	4mm	2mm

Table I b: Showing skeletal changes in vertical plane

	Pre-treatment	Post-treatment
Go Gn – SN	20^0	22^0
Basal plane angle	16^0	18^0
Y- axis	61^0	62^0
Jarabak ratio	74.1%	72.7%
FMA	25^0	25^0
Lower gonial angle	66^0	68^0
Sum of 3 angles	383^0	386^0

GoGn - SN - Gonion Gnathion-Sella Nasion angle, Y-axis - The angle of a line connecting the sella turcica and the gnathion, FMA - Frankfurt Mandibular Plane Angle.

Table I c: Showing skeletal changes in schwarz & Harvold length.

Schwarz length	Pre-treatment	Post-treatment
Maxillary	50mm	50mm
Mandibular	77mm	79mm
Harvold length		
Maxillary	95mm	96mm
Mandibular	117mm	122mm
Ramus length	61mm	65mm

Conclusion:

The Forsus is an effective and comfortable fixed functional appliance which is very effective in repositioning the mandible in a forward position for the treatment of skeletal mandibular retrognathism. The mandible is free to move laterally while not allowed to

Table II: Showing dento-alveolar & soft tissue changes in Maxillary and Mandibular incisors.

Maxillary incisor	Pre-treatment	Post-treatment
U1- NA angle	25^0	18^0
U1- NA (mm)	6.5mm	3mm
U1- SN angle	107^0	104^0
U1 – PP	112^0	104^0
U1 – FHP	109^0	103^0
Mandibular incisors		
IMPA angle	100^0	103^0
L1 – NB angle	27^0	29^0
L1 – NB mm	6mm	7mm
Interincisal	126^0	124^0
L1 – Apog line	0.5mm	1mm
Holdaway ratio	6:7	7.5:7
	Soft tissue	
Nasolabial angle	106^0	117^0
Rickett's line		
For upper lip	2mm ahead	1mm behind
For lower lip	4mm ahead	0mm

U1-Upper incisor, L1-Lower incisor, PP-Palatal plane, FHP-Frankfort horizontal plane, IMPA- Incisor mandibular plane angle, Pog- Pogonion

move posteriorly. However patient compliance is a minor drawback but well tolerated comparatively. The Forsus may be a comfortable alternative to conventional anterior repositioning appliances.

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Case Report

Treatment of Myofascial Pain Dysfunction Syndrome in an Edentulous Patient – A Case Report

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Abstract:

Pain is a complex phenomenon, causing discomfort, suffering and psychosocial morbidity. Myofascial Pain Dysfunction Syndrome (MPDS) is attributed to pain & inflammation of the muscles, with no definitive pathogenesis causing this syndrome. The purpose of this paper is to describe the multidisciplinary approach for the treatment of a 70 year old female patient who suffered from myofacial pain syndrome for the last 10 years. Combined with Trans-cutaneous electrical nerve stimulation (TENS), the construction of a complete denture in order to re-establish the proper vertical dimension leading to decrease in muscular activity thereby eliminating the underlying cause of disease and providing a definitive treatment for the patient with MPDS.

Key Words: Myofascial pain syndrome, Temporomandibular Joint, Trans – cutaneous electric nerve stimulation.

Introduction:

Pain in facial region originating from both temporomandibular joint and jaw muscles is a common clinical problem. There are many synonyms for this condition including Myofascial Pain Dysfunction Syndrome (MPDS), Mandibular Dys-function Syndrome and the Temporomandibular Joint Dysfunction Syndrome (Edmiston & Larsen, 1978). Signs and symptoms of MPDS vary, but generally, the patient complains of one or more of the following: - Pain in the region of the temporomandibular joints (TMJ), tenderness in the region of one or both joints, temporo-mandibular joint sounds like clicking or crepitation, restricted jaw opening, disturbed chewing pattern and locking of jaw (Blasberg & Greenburg, 2003).Muscle pain is one of the commonest chief complaints of the patient and while it primarily involves jaw muscles, some times cervical muscles are affected as well. Headache caused by the muscular tension of the jaw muscles is another presenting feature (Lous, 1976).The precise cause of MPDS is not fully understood. Postural, emotional and behavioral factors may contribute to it (Gerwin, 2004). Consequently, many different therapies including conservative, have been advocated for patients with myofascial pain. A number of successful treatment outcomes have been reported, including occlusal splints, physiotherapy, muscle-relaxing appliances, and pharmacological interventions (Al Ani et al, 2005). Inspite of its diverse etiology, occlusal instability has been long considered an important aetiological factor. In complete denture wearers with mandibular dysfunction, symptoms often disappear after improvement of the occlusion (Carlsson, 1976).

Trans-cutaneous electrical nerve stimulation has proven to be useful in many painful syndromes. Based on Wall & Melzack's Gate Control Theory and later improved as trans-cutaneous electrical stimulator, TENS has been used very commonly for pain relief in the last 30 years (Tarhan et al, 1999). It works by decreasing pain perception and it may be used to control acute and chronic pain.

Case report:

A 70-year-old female patient was referred by her general dental practitioner to the Department of Prosthodontics, People's College of Dental Sciences for treatment of pain & prosthodontic rehabilitation. The patient complained of pain on the right side of face, difficulty in eating and opening the mouth for the last 10 years. The disease was particularly severe for last 2 months. She also reported pain while talking or moving her jaw, intense unbearable pain was perceived anterior to the right ear and radiating to the temple region. She gave a history of being edentulous for last 3 years and was a non denture wearer. Pain was described as being to the score of nine out of ten on the Visual Analogue Scale (VAS).

Pain could be elicited in right joint area during opening and closing the mouth. Using the flat palpation

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technique, tenderness was recorded over massetric muscle which could possibly be termed a myofascial trigger point (Dommerholt, 1995). Based on symptoms and clinical examination the patient was diagnosed to have Myofascial Pain Dysfunction Syndrome. In consultation with an oral physician,a treatment plan was formulated. Patient was put on pharmacotherapy which included Chlorzoxazone 500 mg, Paracetamol 500mg and Diclofenac potassium 50 mg twice daily. Warm fomentation was recommended twice daily for 5-10 minutes and physiotherapy in the form of jaw exercises. Trans-cutaneous electrical nerve stimulation therapy was given by placing skin electrodes in the right pre auricular and massetric muscle region. The pulse width taken was 60 micro-second. At the pulse rate of 80 impulses/ sec. it was given for 15 min. on alternate days for 1 month (Fig. I). Prosthetic rehabilitation was done, paying attention to the impression technique and appropriate designing of the occlusal scheme.

Fig. I Showing placement of skin electrode: right pre-auricular and massetric muscle.

A primary impression of the maxillary denture bearing area was made with a low viscosity irreversible hydrocolloid material (Alginate; DENTSPLY Ltd, UK), to ensure minimal distortion of the displaceable tissues. The final impression was then made using Heavy bodied addition-curing polyvinylsiloxane (Zhermack® clinical polyvinylsilo-xane impression material; Badia Polesine, Italy) impression material which was loaded on the custom tray and seated in the patient's mouth. Subsequently, the material was used for border moulding. The area of the custom tray was then filled with light bodied polyvinylsiloxane impression material.A wash of light-bodied polyvinylsiloxane impression material was also placed over the heavy bodied material that had compressed the 'normal' tissues. This tray was placed in the mouth and allowed to set. Excess material was removed after the material set. The impression was re-inserted to ensure that it was retentive and did not rock when pressure was applied over the displaceable areas. Proper manipulation ensured so that no overextension occurred. The impression was cast in dental stone, paying careful attention to preserving the bordered moulded sulcus area. A heat-cured acrylic transparent base plate was fabricated to assess the accuracy of fit of denture base. Denture fabrication was then continued in the usual manner: Face-bow transfer, re-establishing vertical dimension and arrangement of teeth was done on a

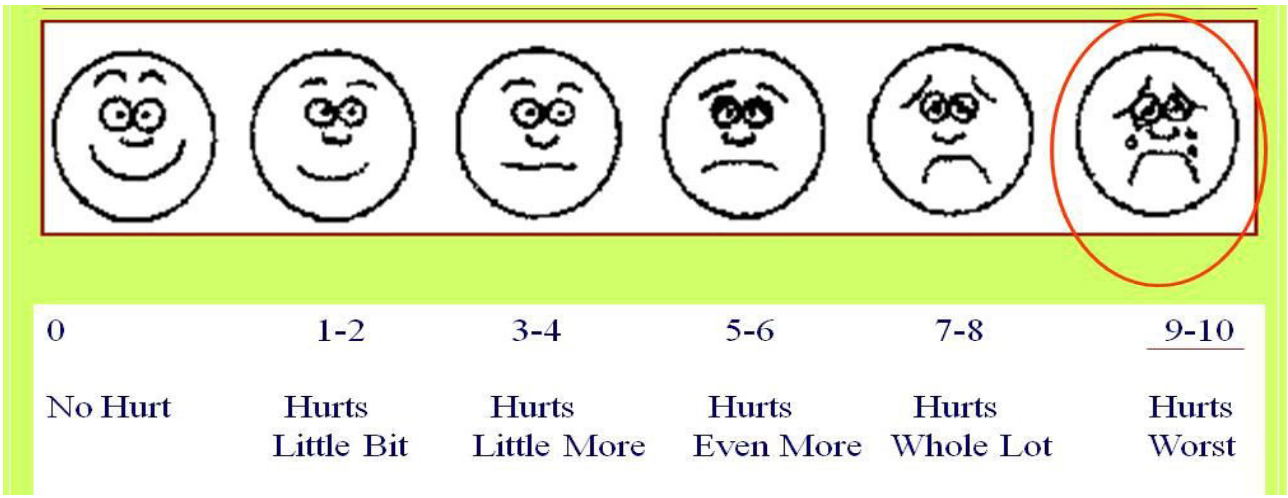

Figure II : Showing how facial expression of patient changes with gradual increase of pain and scores given accordingly: No pain 0; pain can be ignored 1-2; pain interfering with task 3-4; pain interfering with concentration 5-6; interferes with basic needs 7-8 and pain which require bed rest 9-10 .This pain assessment tool is intended to help patient care providers to assess pain according to individual patient

semi-adjustable articulator (Hanau H-2 series@; Water Pik) in order to achieve balanced articulation. Attention was given for even tooth contact in excursive movements of the mandible. The dentures were delivered (Fig. III).

In subsequent review appointments, the patient reported satisfaction with relief in pain as well asstability, aesthetics and function of denture (Fig. IV).

Fig. III: Photograph showing dentures fabricated for patient.

Fig. IV: Photograph showing patient with denture and the adequate muscle support is provided.

Discussion:

Muscular pain or tenderness in and around the joint area, excessive posturing of the mandible and occlusal disharmonies, use of the jaws as a method of releasing emotional tension are some of the supposed causes of MPDS. Myofascial pain syndrome is the most common cause of musculo-skeletal pain in medical practice and should be suspected in all chronic pain patients (Dunteman & Swarm, 1995).

A diagnosis of myofascial pain should be suspected, if the patient exhibits more than one or more of the following signs and/or symptoms:

- Pain on palpation of the temporomandibular joint.
- Pain on palpation of associated mandibular muscles.
- Limitation and/or deviation of mandibular movement. This is assessed by measuring the range of jaw movement, which is the only measurable parameter that can be objectively recorded in relation to temporomandibular disorder.
- Joint sounds and headache. Headache alone or joint sounds alone are not diagnostic of myofascial pain. Joint sounds can be intermittent.

In the present report, using these criteria, the patient was diagnosed as having MPDS.

With the advances in dental techniques and dental treatment philosophies, more patients retain some, or all, of their natural teeth until later in life. Sometimes, unusual arrangements of remaining natural teeth can lead to unfavourable distribution of occlusal forces on the residual alveolar ridges, resulting in bone resorption and loss of vertical dimension muscle fatigue. As a result of accompanying medical conditions or medical treatments, such elderly patients may be unsuited for surgical procedures or intervention. The management of poor denture-bearing areas can be accomplished on the basic principles of complete denture construction without recourse to surgically invasive procedures.

Although the myofascial pain dysfunction syndrome has a multiple aetiology, faulty vertical dimension is a frequent cause of muscular pain among wearers of full dentures. It is well known that bite force and EMG activity are considerably reduced in edentulous patients, more so in edentulous MPDS subjects; endurance time is reduced in such subjects and so is fatigue resistance of the masseter muscles (Tortopidis et al 1999). Monteith (1984) have presented an hypothesis that the amount of free-way space present in an individual is an expression of the contractile power of the masseter and medial pterygoid muscles. They have stated that their method has proved particularly effective in the treatment of denture-wearers presenting with symptoms of the myofascial pain dysfunction syndrome. Based on these assumptions, the establishment of proper vertical dimension was given due importance while constructing dentures in the current case.

Transcutaneous electrical stimulator sends a painless electrical current to specific nerves. The mild electrical current generates heat to relieve stiffness, improve mobility and relieve pain. The treatment is also believed to stimulate the body's production of endorphins or natural pain killers. The duration of pulses

and frequencies can be revised and it is possible to stimulate different types of fibers by chosen stimulation types. It is possible to stimulate selectively Aα, β, and γ carrying touch and position sensation and it is possible to block pain in medulla spinalis level, or to stimulate Aδ and C fibers carrying pain and it blocks the pain in upper levels (Tarhan et al, 1999). In this case TENS proved to be appropriate choice of management.

Optimal function of the postural and facial expression muscles requires a correct support from the natural teeth and the ridge areas or from the adequate designed prostheses. Good muscular control and co-ordination are essential for effective use of complete denture (Jacob et al, 2004). In balanced occlusion, there is equilibrium on both sides of the denture .The denture base is more stable during various functional movements which will be less likely to abuse the foundation tissue which in turn reduces the bone resorption. This reduces the load transmitted to temporomandibular joints and masticatory apparatus. Balanced Occlusion is required for smooth uninterrupted tooth contact in the dynamics of daily mandibular movements (Mohl & Drinnan, 2000) and was one of the objectives in the presented case.

Conclusion:

It is essential that the correct diagnosis be made before treating a case of MPDS. Merely treating the patient symptomatically does not provide long term results, at the same time injecting trigger points and tender spots and hoping for the best does not provide satisfactory results. The patient should be counseled and trained well with jaw exercises as well as acceptance of the denture. The proper treatment of Myofascial Pain Syndrome may be one of the most rewarding if handled correctly.

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Case Report

Esthetic Closure of Diastema by Porcelain Laminate Veneers: A Case Report

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Abstract:

From a purely cosmetic standpoint, value of the appearance of one's teeth has taken on a greater importance in today's society. Multiple options are available to treat the problems arising in the zone of high esthetic sensitivity. Every treatment modality offers some advantages and disadvantages. The use of porcelain laminate veneers to solve esthetic and/or functional problems has been shown to be a valid management option especially in the anterior esthetic zone. This case report discusses a patient having diastema in the anterior region with discolored and chipped off old composite restorations. The patient was treated with porcelain laminate veneers in the maxillary arch for the closure of diastema and replacement of old worn out restoration to obtain satisfactory esthetic result.

Key Words: Diastema, Esthetics, Porcelain, Veneers.

Introduction:

Confidence is important aspect of one's personality and confident smile makes the picture complete. From a purely cosmetic standpoint, the value of the appearance of one's teeth has taken on a greater importance in today's society. People are giving an increasing importance to a healthy and attractive smile. With the advancements in the area of cosmetic dentistry the dental professionals have been offered new opportunities in conservative and esthetic restorative procedures. Multiple options are available to treat problems arising in the zone of high esthetic sensitivity. Every treatment modality offers some advantages and disadvantages. The use of porcelain laminate veneers to solve esthetic and/or functional problems has been shown to be a valid management option especially in the anterior esthetic zone. The techniques and the materials employed to fabricate porcelain laminate veneers offer satisfactory, predictable and lasting results.

There are various ways to treat cosmetic dental problems depending upon the problem per se. Diastema, tooth size discrepancy, discolorations, staining, fractures in teeth, endodontic treatment, and smile designing are some of the reasons for which patient seek esthetic dental treatment. Some restorative techniques are conservative such as use of adhesives and lasers while others are subtractive methods.

Porcelain laminate veneers (PLV) were introduced into dentistry around 1938 (Pincus, 1938). With the introduction of acid etch technique by Buonocore (1955) and silica resin direct filling material by Bowen (1958), interest was generated in PLV. Coupled with silanization of veneers and the introduction in the early 1980s of bonded porcelain veneer (Horn, 1983), the results with PLV have become more predictable. Survival rates have ranged from 92% at 5 years to 64 % at 10 years (Peumans et al, 2004). Carefully placed PLV have reported very high survival rates of over 90% after 9 years stressing the need for the proper case selection and technique (Strassler & Nathanson, 1989; Dunne & Millar, 1993). This case report focuses on a multiple diastema closure by using porcelain laminate veneers.

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Case report :

A 31 year old female patient reported to the OPD of Department of Prosthodontics, Crown and Bridge & Implantology in People's College of Dental Sciences and Research Centre, Bhopal with a chief complaint of discolored anterior teeth and gaps between the teeth. The patient was unhappy with the appearance of her teeth and restrained herself from smiling due to self-consciousness. On examination, diastemas were found in her maxillary and mandibular anterior region involving the first premolar on the maxillary left side (Fig. I & Fig. II). Maxillary left second premolar was Patient had group function occlusion.

Fig. I:Extraoral pre-treatment photograph.

Fig. II: Intraoral pre-treatment photograph showing diastema and discolored composite restorations.

missing. The first molar on same side of maxilla was root canal treated and had a full coverage gold crown with occlusal perforation and short gingival margins. Patient had undergone composite veneering on her maxillary incisors which got discolored and chipped off.

After thorough examination, impressions for diagnostic models were made in irreversible hydrocolloid (Heraplast, Heraeus Kulzer, USA). The models were studied to decide the shape and size of the restorations with help of a diagnostic wax up. To provide a long term solution , the patient was provided the option of PLV. The patient agreed and opted for maxillary correction only as the mandibular anteriors were less visible.

At the onset of the treatment, thorough scaling and polishing was done. The gold crown on the maxillary left molar was replaced by a metal ceramic crown. Before proceeding for tooth preparation, shade was selected using Vitapan Classical shade guide (Vita Zahnfabrik, Germany). The maxillary teeth were then prepared from right first premolar to the left first premolar to receive porcelain laminate veneers . The tooth preparation was kept in enamel at a depth of 0.5 mm using a depth cutting diamond and a tapered diamond 1 mm in diameter. 0.25 mm chamfer was maintained in the cervical region (Fig. III). The chamfer finish lines were kept at the level of gingival margin.

The length of the extruded left maxillary lateral incisor was adjusted corresponding to the incisal plane. The incisal chamfer was extended palatally as little increase in height was desirable. The centric stops were carefully avoided during preparing the palatal finish line. The proximal preparation was extended beyond the contact area to avoid visibility of the tooth restoration junction.

Fig. III: Photograph showing tooth preparation for porcelain veneers

After finishing the sharp line angles and point angles, gingival retraction was performed. Impression of the maxillary arch was made in addition silicone (Affinis, Colte‘ne Whaledent) by single step double mix technique (Fig. IV). In this technique a prefabricated perforated tray was coated with tray adhesive (Coltene adhesive, Coltene Whaledent) and putty consistency addition silicone was loaded on the tray. At the same time light body material was syringed around the prepared teeth to record the fine details and the previously loaded tray was inserted in the mouth to make the impression. Provisional restorations were not required as the tooth reduction was minimal and restricted to enamel.The porcelain laminates were fabricated by refractory die technique (IPS d.SIGN Ivoclar Vivadent, USA). The laminates were tried in for shade, fit, marginal adaptation, shape, size, symmetry and contacts. First they were tried-in individually using glycerin as a holding medium. After individual evaluation, collective try-in was done to appreciate the esthetic enhancement. Patient’s approval was obtained at the time of try-in.

The cementation appointment:

Laminate Preparation: The laminates were arranged on a wax sheet denoting the position of the tooth in the arch to avoid incorrect placement and inadvertent breakage. The laminates were etched with 4 % Hydrofluoric acid (Porcelain Etchant , Bisco, USA) for 3 minutes carefully avoiding contact on the facial surface (Fig.V). After etching, they were washed thoroughly using liberal amount of water. On drying, a coat of Silane coupling agent (Porcelain Primer, Bisco, USA) was applied (Fig.VI) .

Tooth Preparation: The procedure for cementation was

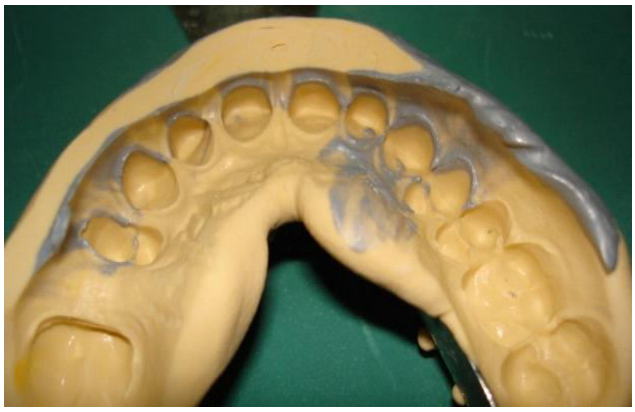

Fig. IV: Photograph showing impression made in addition silicon impression material.

Fig.V: Photograph showing Laminates after etching with hydrofluoric acid.

Fig. VI: Photograph showing silane coupling agent applied on fitting surface of veneers.

Fig.VII: Intraoral post tre-atment photograph.

performed on two teeth at a time starting at the midline. The prepared teeth were etched using 37% Phosphoric Acid (Meta Etchant- 37, Meta Biomed Co. Ltd, Korea) for 15 seconds. On air drying bonding agent (Meta P & Bond, Meta Biomed Co Ltd, Korea) was applied & light cured for 10 seconds. Dual cure composite crown and bridge luting agent (Duolink, Bisco, USA) was used for cementation. The laminates were spot cured for 5 seconds initially. Excess cement was removed with explorer and then complete curing was done for 20 seconds. On completion of the cemen-tation procedure, the occlusion was checked in centric and eccentric positions for interferences. The high points were removed and polished (Fig.VII & Fig. VIII).

Fig.VIII: Extraoral post tre-atment photograph.

Discussion:

The etiology of diastema may be attributed to the following factors: (a) Hereditary- congenitally missing teeth, tooth and jaw size discrepancy, supernumerary teeth & frenum attachments; (b) Developmental problems- habits, periodontal disease, tooth loss, posterior bite collapse (Oesterle & Shellhart, 1999). Treatment planning for diastema correction include orthodontic closure, restorative therapy, surgical correction or multidisciplinary approach depending upon the cause of diastema (Dlugokinski et al, 2002). The restorative closure of diastema can be achieved by using any of the techniques mentioned ; direct composite veneers, indirect composite veneers, porcelain laminate veneers, all ceramic crowns, metal ceramic crowns and composite crowns ((Dlugokinski et al, 2002; Rammelsberg et al, 2005).

Composite resin and porcelain are the most frequently used veneering material for diastema closure conservatively. Smaller diastema can be closed with microfilled and hybrid resins if the diastema is about 1-1.5 mm in dimension. Composite resin is easy to use, requires less appointments, is economic but offers less wear resistance and surface staining, which makes it inferior to dental porcelain. Besides, failure of the same prompted the patient to opt for porcelain laminates in the current case (Cho et al, 1998).

It has become increasingly apparent that conservation of tooth structure is a major factor in determining the long term prognosis of any restorative procedure. One of the most important advantages of bonded porcelain veneers is that they are extremely conservative in terms of tooth reduction. In the current case, only 0.5 mm reduction on the labial surface was done. This minimal reduction rarely, if ever, leads to pulpal involvement which is a major advantage. The highly glazed surface of the porcelain laminates prevents plaque accumulation, considered important to attain a healthy periodontal response. Excellent esthetics could also be achieved due to lifelike appearance of porcelain and scattering effect of the luting cement.

However, porcelain laminates have their own limitations too. They should not be used when remaining enamel is inadequate to provide adequate retention. Large Class IV defects should probably not be restored with veneers because of the large amount of unsupported porcelain and the lack of tooth-colored backing. The amount of unsupported porcelain should be carefully evaluated in cases with a large diastema . Darkly stained teeth are not optimally restored with veneers. The prognosis for veneers in bruxing is doubtful. Certainly, such patients should be instructed to use a night guard after final restoration (Sheets & Taniguchi, 1990).

Even, if the laminates fail in the long run, the conserved tooth can still be treated with a full crown restoration. Porcelain laminate veneers offer a predictable and successful treatment modality that preserves a maximum of sound tooth structure. An increased risk of failure is present only when veneers are partially bonded to dentin. The estimated survival probability of porcelain laminate veneers over a period of 10 years is 91% (Dumfahrt & Schäffer , 2000).

Conclusion:

Bonded porcelain veneers can provide successful esthetic and functional long-term service for patients. Porcelain laminate veneers offers more-extensive applications when they are used cautiously and the results achieved have been gratifying for the cosmetic dentist and the patient alike. It has become increasingly apparent that conservation of tooth structure is a major factor in determining the long-term prognosis of any restorative procedure.

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Case Report

Impaction of the Maxillary Central Incisor Associated with Supernumerary Tooth: Surgical and Orthodontic Treatment

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Abstract:

Impaction of maxillary permanent incisor is not a frequently case in dental practice, but its treatment is challenging because of its importance to facial esthetics. Supernumerary teeth are the main cause of impaction of upper incisor. Supernumerary teeth when present can cause both esthetic and pathologic problems. Supernumerary teeth in the maxillary midline are common. Early detection of such teeth is most important if complications are to be avoided.

We report a case of 12 year old male with an impacted supernumerary tooth in the maxillary anterior region, which was interfering with the eruption of the permanent, left central incisor. The impacted supernumerary tooth was surgically removed. With the application of an orthodontic traction, impacted left maxillary central incisor was brought down to its proper position in the dental arch.

Key Words: Impacted incisor, orthodontic traction, supernumerary.

Introduction:

Although the impaction of a permanent tooth is rarely diagnosed during the mixed dentition period, an impacted central incisor is usually diagnosed, when there is a delay in the eruption of the tooth. Supernumerary teeth are the main cause of impaction of upper incisor (Smailene, 2006). Supernumerary teeth are the extra teeth formed due to the disturbances during the initiation and proliferation stages of tooth development (Bergstrom, 1977; Humerfelt, 1985). The supernumerary tooth present in the midline or just lateral to the midline is referred to as mesiodens.

Supernumerary teeth are most frequently located in the maxillary incisor region (64.3%) with mesiodens accounting for 32.4% of such presentation. 56-60% of premaxillary supernumerary teeth cause impaction of permanent incisor (Gregg and Kinirons 1991; Becker, 1998) due to a direct obstruction for the eruption tipping of adjacent teeth towards the place of the impacted tooth, narrowing of the dental arch, displacement of the permanent teeth bud, or malformations of the unerupted tooth root (Rajab and Hamdan 2002; Roberts-Hary and Sandy 2004).

An interesting case of an impacted supernumerary tooth in the maxillary anterior region, interfering with the eruption of the permanent left central incisor is presented. Combined surgical and orthodontic treatment employed, to bring the impacted left maxillary central incisor to its proper position in the dental arch is discussed.

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Case Report:

A 12-year-old male patient reported with the chief complaint of unerupted upper left front tooth. Patient had no significant medical history & Dental history and intra oral examination revealed missing maxillary permanent left central incisor (Fig. I). An intra oral periapical radiograph of upper anterior region demonstrated an impacted supernumerary tooth and an impacted permanent left central incisor (Fig. II). Upper occlusal radiograph was taken which showed the presence of supernumerary tooth (Fig. III) and SLOB (same side lingual, opposite side buccal)

Fig. 1: Intraoral view of the patient showing the unerupted maxillary permanent left central incisor.

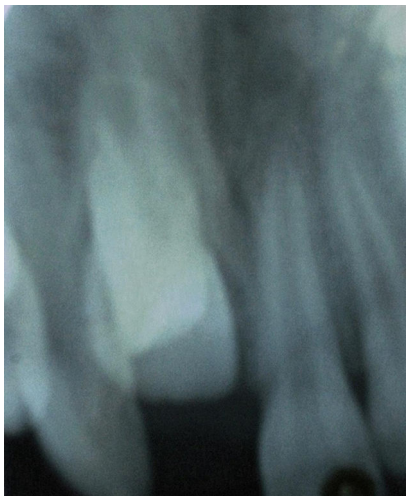

Fig. II: Intraoral periapical radiograph showing supernumerary tooth and an impacted maxillary left central incisor.

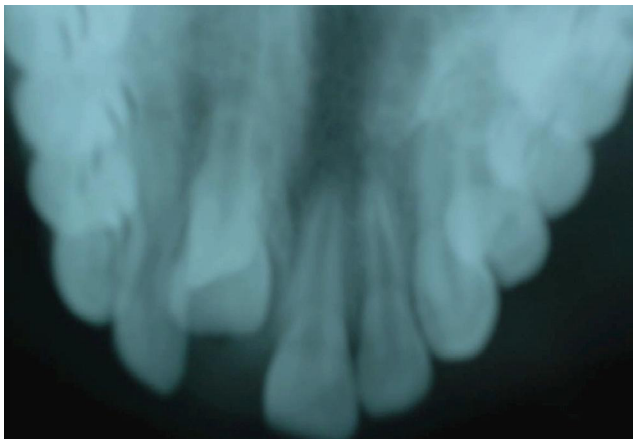

Fig. III: Anterior maxillary occlusal radiograph showing supernumerary tooth.

technique with two intra-oral periapical radiographs confirmed the presence of supernumerary tooth on the palatal side and an impacted tooth in the buccal side

The treatment plan comprised of surgical removal of the supernumerary tooth and orthodontic traction of the impacted incisor with closed eruption technician to bring it into proper position in the dental arch. With the patient under local anesthesia, full thickness mucoperiosteal flap on the palatal side was reflected. After careful elevation of the flap, adequate amount of bone was removed using the rotary cutting instruments and the impacted supernumerary tooth was exposed (Fig. IV). The supernumerary tooth was removed surgically and extraction socket was inspected for any pathology. The extracted supernumerary tooth was conical in shape. The palatal mucoperiosteal flap was repositioned but not sutured at this time. A full thickness mucoperiosteal flap was reflected labially, the bone and the follicular connective tissue covering

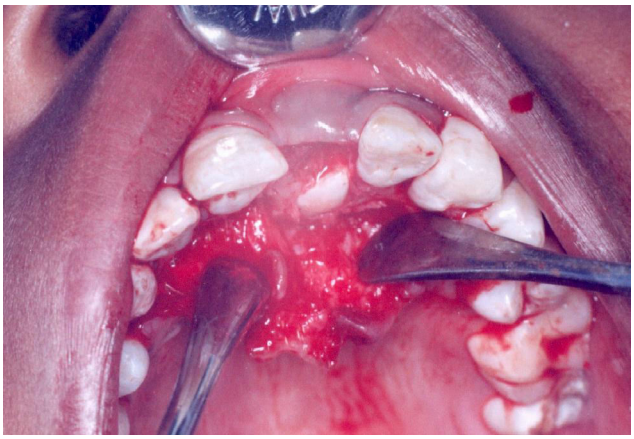

Fig. IV: Operative view showing the supernumerary tooth on the palatal side.

Fig. V: Operative view showing the impacted left central incisor on the labial side.

the impacted incisor was removed and adequate amount of crown was exposed for bonding of the orthodontic bracket (Fig. V). Ligature was twisted to the flat Begg's incisor bracket and made into a hook form and was bonded on the labial surface of the impacted incisor. The labial and palatal flap was repositioned and sutured, keeping the ligature wire hook suspended in the oral cavity making sure the occlusion was not interfered (Fig. VI). After a week, the healing was normal and the sutures were removed. Begg's bracket was bonded on lower permanent incisors and canines and 0.020 A. J. Wilcock arch wire (sectional) was used for anchorage. Yellow elastic was tied to the ligature wire hook and was engaged to the lower brackets for the traction (Fig. VII). Elastic was engaged more towards the left side of the mandibular teeth so as to de-rotate the impacted incisor. The patient was demonstrated about how to engage the elastics and was told to disengage the elastics during eating and long speech. Elastics were changed every fifth day. After two weeks of traction with the yellow

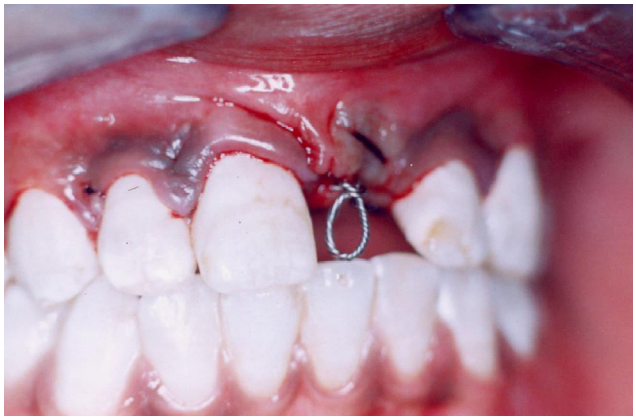

Fig.VI: Post operative view showing sutured site and suspended ligature wire hook.

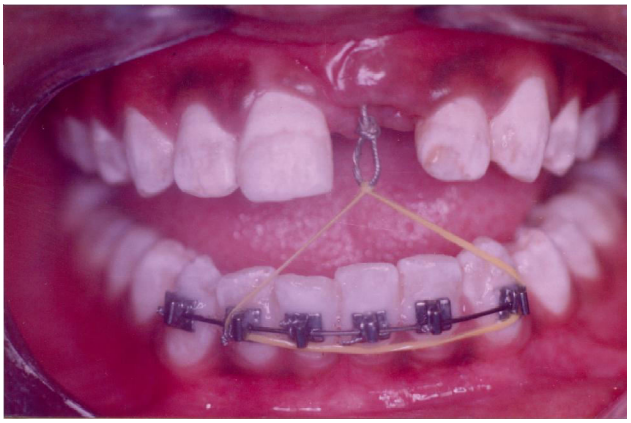

Fig.VII: Yellow elastic tied to the ligature wire hook and engaged to the lower brackets for the traction

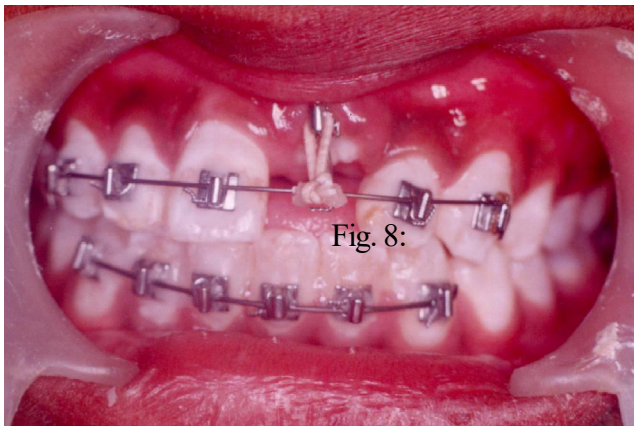

Fig. 8:

Fig.VIII: Elastic thread tied from the slot of the bracket to the sectional arch wire for further traction.

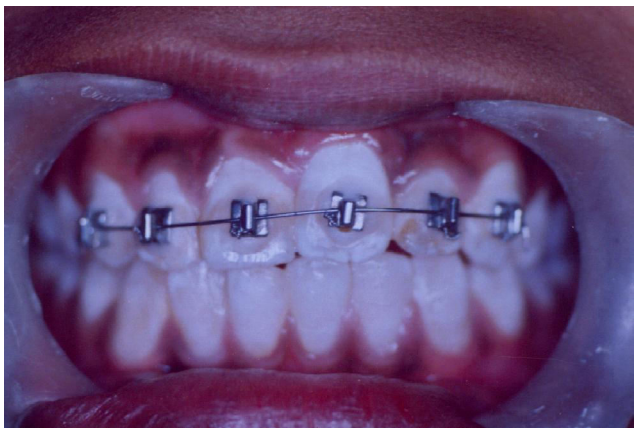

Fig.IX: Placement of 0.016 NiTi round arch wire to align the left central incisor.

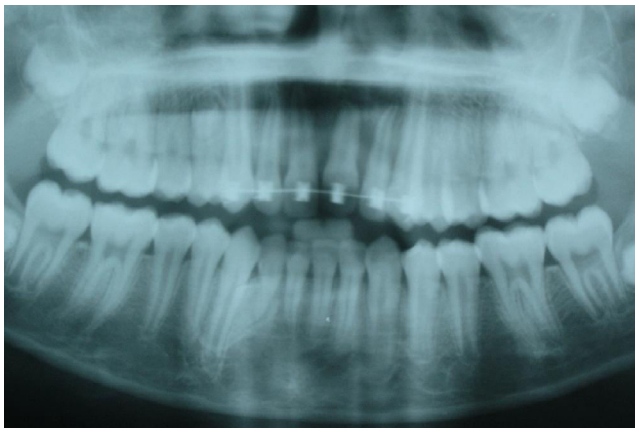

Fig. X: OPG showing well aligned left central incisor without any bone resorption

Fig. XI: Six-month post treatment intraoral view of the patient showing well aligned left central incisor.

elastics, the incisor with the bracket was seen in the oral cavity. Begg's bracket was bonded on permanent maxillary left central incisor, lateral incisor, and canine and right lateral incisor and canine. 0.020 A. J. Wilcock arch wire was used for anchorage. The ligature wire hook was cut till the arch wire and the remaining part was passively tied to the arch wire. Elastic thread was tied from the slot of the bracket to the sectional arch wire for further traction of left central incisor (Fig. VIII). After the crown of the impacted incisor was sufficiently erupted, 0.016 NiTi round arch wire (sectional) was used to align the incisor. Once the incisor was well aligned the mammelons were trimmed and lingual fixed retention was given. The patient showed normal clinical crown length with acceptable

gingival contour (Fig. XI) and the tooth maintained its vitality with no evidence of root resorption (Fig. X). At six-month follow up (Fig. XI), the left maxillary incisor remained vital and responded normally to percussion and mobility and sensitivity testing with good width of attached gingiva.

Discussion:

Supernumerary teeth can affect the normal position and eruption of adjacent teeth and often require clinical intervention (Harris and Clark, 2008). The most common complication due to presence of supernumerary teeth is the failure of eruption of maxillary incisors (Rajab and Hamdan 2002). Supernumerary teeth in the premaxillary region are broadly of two types: one containing teeth of normal morphology known as supplemental teeth and the other of abnormal shape. The latter class has been further categorized into the conical type (peg-shaped) and the tuberculate type. The tuberculate supernumerary tooth seems to occur most frequently palatal to the upper central incisor and to be later in its development than the conical tooth. It also tends to delay or prevent the eruption of the corresponding permanent central incisor, and is rarely seen erupted in childhood. It has also been documented that the conical-shaped supernumerary tooth does not usually affect the eruption of the adjacent permanent incisors but may cause their displacement, which may involve the crown, the root or the whole tooth. The conical supernumerary may be non-inverted or inverted. When non-inverted, it may remain unerupted palatal to the permanent incisors. When inverted, it may point posteriorly towards the nose or may even erupt into the nose (Mills, 1987; Profitt, 1992). In the present case the associated supernumerary tooth was conical, non -inverted and impacted on the palatal side and interfered with the eruption of the permanent tooth.

The treatment protocol available for management of impacted permanent teeth due to supernumerary teeth are diverse. Methods of management of crowding or impaction due to supernumerary tooth are; removal of supernumerary teeth or tooth only, removal of supernumerary teeth and bone overlying impacted teeth, incision of fibrous tissue over the alveolar ridge to promote the eruption with or without orthodontic traction (Regezi et al., 2003; Bhat, 2006).

Spontaneous eruption of impacted maxillary incisors occurs in 54-76% of cases when supernumerary tooth is removed and it there is enough space in the dental arch (Crawford, 1997; Garvey et al., 1999). However, research data indicate that the spontaneous eruption of impacted maxillary incisor may take up to 3 years and sometimes orthodontic treatment is necessary to achieve adequate alignment of the erupted tooth in the dental arch (Witsenburg et al., 1981; Mason et al., 2000). If the root of the impacted tooth is still developing, the tooth may erupt normally; but, once the root apex has closed, the tooth has lost its potential to erupt (Kokich and Mathews, 1993). In the present case the root formation was almost complete and because of its rotation and labial placement, it was not desirable to wait for spontaneous eruption.

After thorough clinical and radiographic examination, it was decided that the present case required a combination approach comprising of both surgical and orthodontic treatment to bring an unerupted maxillary central incisor into position as done by various authors (Cangialosi, 1982; Kamakura et al., 2002; Kocadereli and Turgut, 2005). Surgical exposures of impacted incisors or surgical repositioning have also been used to bring impacted teeth into occlusion (Kamakura et al., 2002; Kocadereli and Turgut, 2005). Combination approach using conservative surgical treatment and careful orthodontic management to bring tooth into good position in the dental arch has also been reported with success (Cangialosi, 1982). Hence, extraction of the impacted supernumerary tooth was done and was followed by an innovative orthodontic traction of the unerupted permanent central incisor to bring the tooth into proper position in the arch.

Three accepted ways of surgical exposure have been suggested by Becker (1998) as:

a. Circular excision of the oral mucosa immediately overlying the impacted tooth.
b. Apically repositioning of the raised flap that incorporates the attached gingiva overlying the impacted tooth.
c. Closed eruption technique in which the raised flap that incorporates attached gingiva is fully replaced back in its former position after an attachment has been bonded to the impacted tooth.

The closed eruption technique has been favoured by many clinicians who claim that the aesthetic and periodontal outcome is far more superior when compared with the circular excision and apically positioned flap technique (Lin, 1999; Uematsu et al., 2004; Paola et al., 2005). In the presented case the

closed eruption technique was used for better and esthetic gingival margin. At the end of the treatment, patient showed normal clinical crown length with acceptable gingival contour.

The extrusion force applied on the impacted central incisor in the present case was very light and measured in the range of 40-50 grams. This may have accounted for the little difference in the clinical crown length and maintenance of vitality of the impacted tooth post-alignment. The chances of nonvitality are naturally much lower when the treatment is initiated at a younger age due to the presence of a wide apical foramen (Chawla and Kapur , 2009), but in the present case the patient was 12 years old at the time of initiation of the treatment. In our view, forces for traction greater than 50 grams should not be applied as it may be the cause of nonvitality as reported by Uematsu et al. (2004). In the present case the duration of treatment was around 7-8 months and the aligned left maxillary incisor remained vital and responded normally to percussion and mobility and sensitivity testing.

Early diagnosis of the maxillary central incisor impactions with surgical removal of supernumerary tooth coupled with adequate space spontaneous eruption of the impacted maxillary central incisors (Smailene, 2006). If the impacted tooth is diagnosed at a later stage with its root completely formed or if present in the unfavorable position, combination of surgical and orthodontic treatment has to be carried out.

Conclusion:

Supernumerary teeth may result in the non-eruption of adjacent permanent incisors. Early diagnosis of the presence and removal of supernumerary teeth is essential. Maxillary permanent left incisor was successfully positioned in the maxillary arch by surgical exposure and orthodontic traction, which showed good stability.

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Case Report

Inverted Maxillary Third Molar Impaction - A Case Report

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Abstract:

Inverted maxillary third molar impaction is a rare occurrence. We report a case of 30 year old female who complained of pain in upper part of face on left side. She was diagnosed a case of inverted third molar impaction. She was treated surgically with successful resolution of her symptoms.

Key Words: Inverted molar, impacted molar, maxillary impaction.

Introduction:

The frequency of maxillary third molar impaction has not been very well researched. In a few studies it has been found that in one out of four individuals a maxillary third molar is impacted (Dachi & Howell,1961; Hugoson & Kugelberg, 1988). Most of the impacted third molars are found in a vertical position, but rarely an inversion of the impacted tooth in which crown pointing towards maxillary sinus and root apex facing towards alveolar crest have been reported (Gold & Demby,1973; Held, 1979; William, 1957). The diagnosis is usually made during pre-operative radiological examination.

Case report:

A 30 year old female reported with a chief complaint of pain in the upper part of face of left side since one weak. Family and personal histories were unremarkable. There were no abnormalities in general growth and development. There was no history of trauma. Clinical examination revealed missing tooth 28 with a distal periodontal pocket in relation to tooth 27. An intra oral radiograph revealed presence of an impacted maxillary third molar in an inverted position. A panoramic radiograph was taken to study its relationship with adjacent structures (Fig.I). As the symptoms were acute and not recurrent in nature and further considering the possibility of post surgical morbidity, it was initially decided to manage conservatively. However as no symptomatic improvement was noticed, the tooth was extracted by transalveolar method using standard surgical protocols, after explaining all due risks. The procedure was well tolerated and no significant post-operative complication was noticed.

Fig. I: Panoramic view showing inverted molar on left side (arrow).

Discussion:

On detailed literature search only six case reports of inverted teeth were found. Among these only two had impacted maxillary third molars (Gold & Demby, 1973, Held, 1979). In all case reports the management of impacted molars was done conservatively. Tooth impactions can occur because of various reasons, such as: (i) mechanical obstruction in the path of eruption, which may include hard tissue abnormalities like odontomes,soft tissue conditions such

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as myxofibrous hyperplasia and ameloblastic fibroma; (ii) malpositioning of the tooth germ, either due to trauma or unknown reasons, leading to an abnormal path of eruption, which causes impactions due to lack of space; or (iii) primary failure of eruption of well-formed tooth may have strong genetic component or it could be an acquired condition, occurring due to a temporary alteration of the nerve activity in the region which, in turn, has an influence on the eruption process (Kapur et al, 2008). Access to inverted maxillary molars can be a problem, since the largest circumference of the tooth (crown) is towards the sinus and the infratemporal fossa. One of the complications that could happen during such surgery is the tooth displacement into these spaces (Winkler et al, 1977; Oberman et al, 1986). Standard surgical protocols for extraction of an impacted tooth were followed and the follow-up period was uneventful. Important aspect of management of such inverted impacted maxillary third molar is to carefully weigh the risk and benefits associated with surgical removal of the same.

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Case Report

Conservative Management of Mandibular Second Premolar Impaction

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Abstract:

The mandibular second premolar is one of the most frequently impacted teeth. The recommended treatment is to extract the second primary molar with or without removing the bone along the eruption path, to uncover the tooth surgically and move it into the arch by orthodontic treatment. This paper reports the conservative management of an impacted left mandibular second premolar which exhibited self-correction and erupted into occlusion within 18 months. The purpose of this article is to review the principles of case management of impacted mandibular premolars and to illustrate their potential to respond well to treatment.

Key Words: Impaction, Mandibular Premolar, Submerged tooth.

Introduction:

An impacted tooth is one that is prevented to erupt in its normal functional position by bone, tooth or fibrous tissue (Andreasen, 1997). Tooth impaction is a frequently observed anomaly of eruption in dental practice. The prevalence of premolar impaction has been reported to be 0.1% to 0.3% for maxillary and 0.2% to 0.3% for mandibular premolars (Thilander & Myrberg, 1973; Oikarinen & Julku, 1974). According to the frequency of impaction- Mandibular second premolars (MnP2) rank third-after third permanent molars and maxillary permanent canines. (Alling & Catone,1993). The most common cause of mandibular second premolar impaction is premature loss of deciduous predecessor (Carr, 1963 ; Maclaughlin et al 1967). Impaction of the MnP2 has also been related to the initial angulation of the tooth and the early loss of the first permanent molar (Sutton, 1969). The other causes leading to this problem include, over-retained or infraocclusal and ankylosed primary molars (Winter et al 1997); ectopic positioning of the developing premolar tooth buds; or pathology such as inflammatory or dentigerous cysts (Rubin et al, 2002; Mahajan et al, 2006; Yawaka et al, 2002); extrinsic obstructions, such as supernumerary teeth and odontomas (Kaugars et al, 1989). They may also be associated with, thick and fibrous gingival tissue or with syndromes such as cleidocranial dysostosis (McDonald et al, 1994). Impaction of second mandibular premolar may lead to several problems in occlusion such as loss of space due to mesial drift of molar and distal movement of mandibular first premolar, lower midline shift towards the impacted side, spacing in the mandibular arch and deep overbite.

There are several treatment options available to manage this problem. First, the impacted tooth can be extracted and the resulting space can be closed by orthodontic mechanotherapy. From periodontal point of view, extraction of unerupted mandibular second premolar may leave a marked bony defect in the area, even after the adjacent teeth have been fully uprighted. Prosthetic rehabilitation can be considered in non–extraction cases, after second premolar space has been reopened by orthodontic mechanotherapy. Another alternative will be to uncover the tooth surgically and move it into the arch by orthodontic treatment. The time span required for this treatment may be long and depends upon several factors, such as the initial distance between the tooth and the occlusal plane, angulation of the impacted tooth, age of the patient, the stage of the development of the particular tooth and the manner in which hard and soft tissue healing occurs after the surgical procedure (Kokich & Mathews, 1993; Proffit et al, 2000). The case described below illustrates the inherent potential for even the most unfavorably impacted mandibular premolars to respond

Case Report:

An 18 year old girl was referred to the Department of Orthodontics with the chief complaint of mild pain and pus discharge from lingual surface of left mandibular region. Her medical and dental history was not significant. She had no history of dental extractions or orthodontic treatment. Clinical examination revealed normal development of dentition except the submerged left primary mandibular second molar and absence of mandibular left second premolar. The submerged deciduous mandibular left second molar

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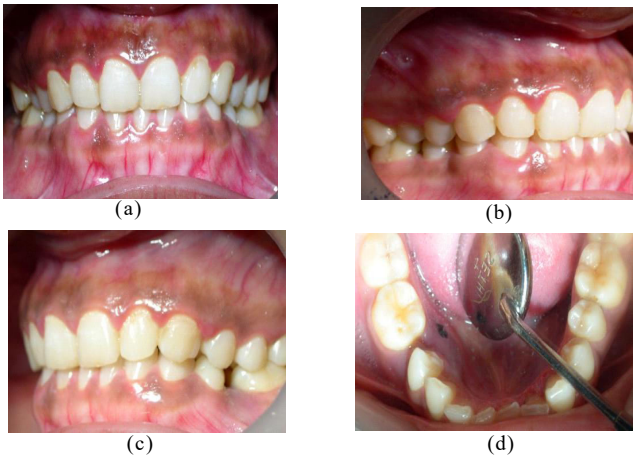
was identified as site of pus discharge, and was located at lingual surface of left posterior mandibular alveolar process near lingual sulcus and almost completely covered by gingivae. There was a mesial shift of first mandibular permanent molar and distal tipping of first mandibular left premolar on the affected side, leaving about 3 mm of space for impacted tooth. There was mild crowding of lower anteriors with deep bite and mild attrition of lower anterior teeth (Fig. I).



(a) (b) (c) (d)

Fig:I. Pre-treatment intra-oral photographs showing (a) Frontal view with deepbite & midline deviation (b) Right lateral view (c) Left lateral view showing missing second premolar (d) Occlusal view with sub-merged primary left second molar.

OPG confirmed the presence of all the permanent teeth, including the third molars. The left mandibular second deciduous molar was submerged between roots of first molar and first premolar; left mandibular second premolar was almost horizontally impacted with crown facing towards first molar. The impacted tooth was located below deciduous submerged tooth and in close proximity to inferior alveolar nerve canal (Fig. II).

Based on clinical and radiographic findings the submerged primary molar was extracted surgically. A pre- adjusted edgewise appliance (0.022" slot) was placed in the upper arch initially. A 0.016" Nitinol arch wire with .017×.025 TMA intrusion arch was placed in upper arch first with the objective of correction of deep overbite. Leveling and aligning was accomplished through sequential change in arch wire from 0.019" × 0.025" heat activated NiTi to 0.019" × 0.025" SS wire. After six months appliance was placed in mandibular arch, with 0.016" Nitinol arch wire being placed as the initial archwire. After two months, 0.018" SS wire with Nitinol open coil spring was placed between mandibular first premolar and first molar to create space for the second premolar. Once adequate space was created, cusp tip of the impacted second premolar was seen

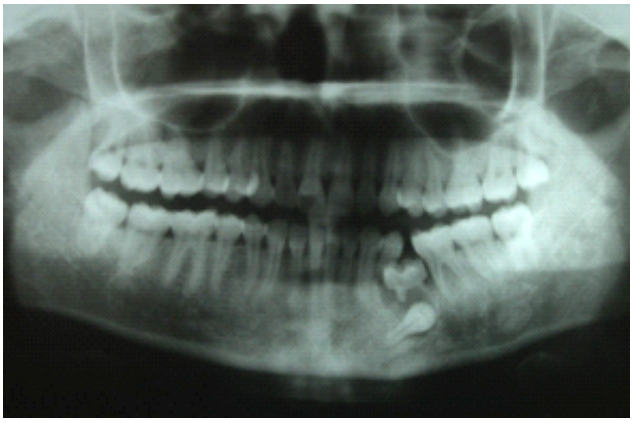
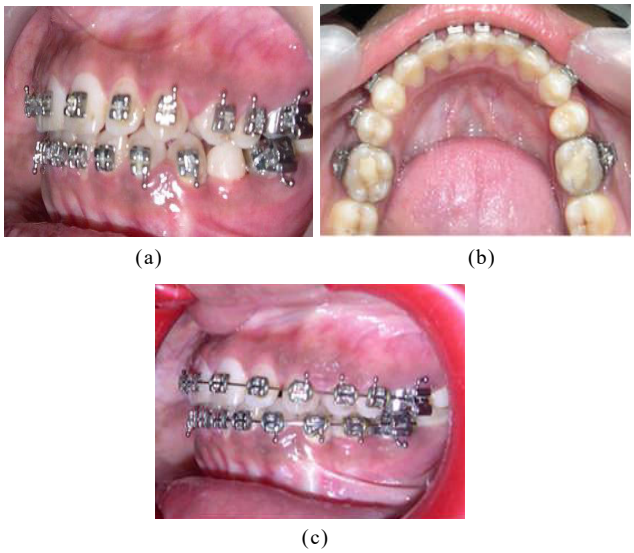


Fig: II. Pre-treatment OPG showing sub merged left primary mandibular second molar & impacted left second premolar.



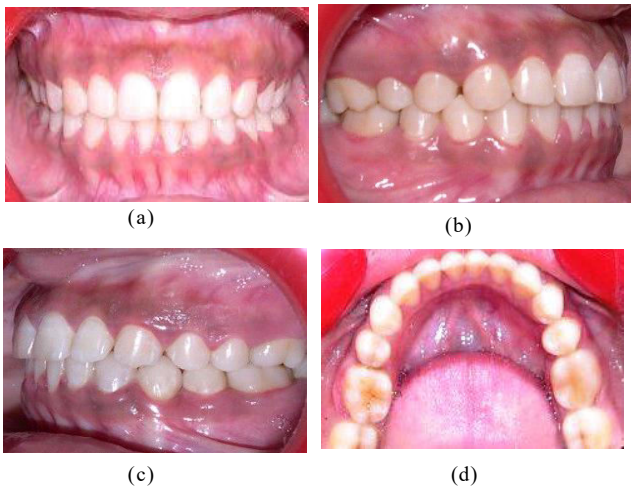
(a) (b) (c)

Fig.III: Mid treatment photograph showing spontaneous erupetion of left mandibular second premolar (a) Left lateral view (b) Occlusion view (c) Alignment of the erupted premolar

clinically. After ten months of treatment in lower arch, the second premolar erupted spontaneously into the occlusion without applying any force onto it (Fig.III). A bracket was bonded to the erupted premolar for final positioning of the tooth. The objectives of eruption of impacted tooth into the occlusion, correction of deep overbite and correction of midline deviation were achieved. The appliance was removed 19 months after initiation of the treatment (Fig. IV & V).

Discussion

Literature specific to impacted premolars is not extensive despite the fact that mandibular second premolars alone account for approximately 24% of all dental impactions excluding third molars (Thilander & Myrberg, 1973) and exhibit dramatic intraosseous migration (Okada et al, 2002). Treatment options for



(a) (b) (c) (d)

Fig: IV: Post treatment photographs showing mandibular second premolar in occlusion.

Fig. V: Post treatment OPG with left mandibular second premolar in occlusion.

impacted teeth include observation, intervention, relocation and extraction (McNamara & McNamara, 2005). On occasion, there may be some interaction between these treatment options (Frank, 2000). Observation involves no treatment other than monitoring the patient clinically and radiologically. Generally it involves following a child or adolescent for a specific time, which can be divided into pre-impaction and post-impaction periods. Intervention may involve simple extraction of a tooth or teeth, usually primary. Intervention may include a brief period of orthodontic treatment to eliminate the impaction. If sufficient space exists or created in the dental arch, impacted MnP2 then has a high potential for self-alignment and eruption without orthodontic intervention (Collett, 2000). Relocation refers to either surgical repositioning of the impacted tooth or, more commonly, orthodontic eruption of the impacted tooth. Orthodontic relocation may be more demanding in terms of time but results in fewer long-term complications (Kokich & Mathews, 1993; Frank 2000). The position and angulation of the impacted tooth, length of treatment time, available space and the presence of keratinized gingival tissue are few critical factors that affect the prognosis and treatment outcome of this condition. Operational complications, none of which occurred in this case, include injury to adjacent periodontium, injury to adjacent teeth, nerve damage, multiple exposures of the impacted teeth and failure of the orthodontic bond when performing a closed-flap eruption procedure (Alling & Catone, 1993; Kokich & Mathews, 1993; Proffit et al, 2000; Frank, 2000).

In selecting an appropriate treatment option, the underlying etiological factors, space requirements, need for extraction of primary molars, degree of impaction and root formation of the impacted premolar should be considered. Factors such as the patient's medical history, dental status, oral hygiene, functional and occlusal relationships and attitude toward and compliance with treatment will influence choice of treatment options. (Kokich & Mathews, 1993; Proffit et al, 2000; Okada et al, 2002; McNamara & McNamara, 2005; Frank, 2000; Collett, 2000).

The treatment outcome was uncertain in this case due to the submerged primary molar below alveolar bone height, severity of impaction, the completion of root formation of the impacted premolar, the reduced level of dentoalveolar bone and proximity of the impacted tooth to inferior alveolar canal. The patient's age and lack of growth potential further complicated the situation. Adding to the complexity of the problem, the mandibular left second premolar was transversely impacted with the crown facing distally (Fig. II).

An erupting tooth follows the line of least resistance (Sutton, 1968). Jacobs (1987) advocated that the removal of bone over the eruption path of the MnP2 should follow extraction of the second primary molar. In the present case, after extraction of submerged tooth, orthodontic procedures were applied to regain space for the impacted premolar tooth. Subsequently the mandibular second premolar erupted spontaneously and finally aligned into the arch with fixed orthodontic appliance.

Although the degree of impaction in this case was marked, presence of submerged second primary molar and a large bone defect left after extraction of submerged tooth may have been a contributory factor in the rapid and efficient alignment of her impacted premolar. Andreasen (1997) suggests that surgical exposure should be confined to cases, both maxillary and mandibular, with no more than 45° of tilting and

limited deviation from the normal position. Reported case fell well outside these guidelines. This case report suggests that the degree of premolar impaction, the early onset-late diagnosis of submerged primary tooth with impacted mandibular premolar, the lack of dentoalveolar bone and root form are not definitive obstacles to the spontaneous eruption and relocation of impacted mandibular premolars.

Conclusions:

Patient's age, early onset submergence of primary molar, disruption to dentoalveolar bone development, severity of impaction, and premolar root form at presentation did not prove an obstacle to successful treatment. Space regaining is the key to successful treatment of these cases, since eruptive movement is always directed towards the site of least resistance.

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Case Report

Giant Cell Lesion of the Jaw: A Case Report in a Child

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Abstract:

Giant cell lesions of the jaw include cherubism, central giant cell granuloma (CGCG) peripheral giant cell granuloma (PGCG) aneurysmal bone cyst, traumatic bone cyst and jaw tumour of hyperparathyroidism. The histological, radiographic and clinical diagnosis is particularly difficult in these types of lesions due to their variable clinical behavior and identical histological presentation with abundant giant cells. We present the case of a 12-year-old boy, who developed a painless swelling of approximately 4 cm, in the left angle of the mandible. The lesion demonstrated slow, progressive and continuous growth. The patient was surgically treated by a conservative approach. The histopathology confirmed the suspected diagnosis of central giant cell granuloma.

Key words: Giant cell, Reparative granuloma, CGCG.

Introduction:

There are a number of lesions that occur in the jaws that contain giant cells within them. They include cherubism, giant cell granuloma of the jaws, giant cell tumour, aneurysmal bone cyst, traumatic bone cyst and jaw tumour of hyperparathyroidism. Their relationship to each other, however, is ill defined. The histological similarities cease with the finding of multinucleated giant cells of osteoclastic origin (Liu et al, 2003) and the lesions themselves greatly differ in their genetic origin, etiopathogenesis and clinical behaviour.

The central giant cell granuloma (CGCG) of the jaws accounts for approximately 7% of all benign tumors of the jaws (Kramer et al, 1991). The CGCG may occur at any age, but it is most commonly seen in the first 3 decades. 37.5% of CGCGs are located in the incisor, canine, and premolar regions of the mandible (Kaffe et al, 1996). CGCG of the jaw is usually unifocal and have traditionally been treated surgically; the common therapy being curettage or resection (Kermer et al, 1994; Eisenbud et al, 1988). We present a case of a central giant cell granuloma in a child patient who was managed by a conservative surgical approach.

Case report 1:

A 12 year-old boy reported to the Department of Oral Medicine and Radiology, People's Dental Academy with a swelling in the left angle of the mandible of one year duration. The swelling had remained asymptomatic while gradually enlarging to cause the facial disfigurement evident at the time of presentation. No history of trauma was elicited nor any systemic or local infections. The boy along with a twin was the eldest child of 4 siblings borne of a non-consanguineous marriage. The prenatal history was unremarkable and delivery was at full term and normal. There was no history of similar disease in any of the siblings or the parents of the affected child. A physical examination revealed a moderately built and nourished male with no known systemic disorder. A facial asymmetry due to a poorly defined solitary swelling in the left angle of the mandible measuring 3x4 cms was noted (Fig.I). The overlying skin appeared normal, while

Fig. I: Extraoral Swelling in left angle of mandible.

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the swelling itself was bony hard and non tender to palpation. Intra oral examination showed a diffuse enlargement in the alveolar portion of the entire left mandibular teeth # 36, 37, 38 region with obliteration of the buccal vestibule in the same region. Teeth # 37 and 38 were clinically missing. Tooth displacement and mobility were not evident in the same quadrant. The overlying mucosa appeared normal.

The swelling was non tender and bony hard on palpation with some areas of fluctuance in the buccal aspect. The adjacent dentition and the oral mucosa did not reveal any abnormality. A tooth vitality test revealed normal pulpal response of the teeth in the same quadrant. A provisional diagnosis of dentigerous cyst was made with the differential diagnosis of ameloblastoma, central giant cell granuloma, odontogenic myxoma and fibrous dysplasia.

The radiographic examination with an orthopantomogram (Fig. III) revealed a solitary well defined multilocular radiolucent lesion in the region of left mandibular angle and ramus. The lesion measured 2 X4 cm extending to involve the left coronoid with distinct and sclerotic borders except in the region of the superior aspect. Multiple overlapping locules appearing as 'soap bubbles' were noted within the lesion along with an unerupted tooth follicle of permanent left mandibular second molar. The mandibular canal was inferiorly displaced while areas of root resorption were not present. The maxilla did not reveal any abnormalities. The radiographic features led us to consider a diagnosis of ameloblastoma or a central giant cell granuloma. Ameloblastoma and central giant cell granuloma may appear unilocular or multilocular with a honeycomb or soap bubble appearance. Odontogenic myxoma may appear as a poorly defined or well-circumscribed radiolucent defect, which may be unilocular or multilocular with a tennis racquet appearance. Serum calcium, phosphorous and alkaline phosphatase levels were found to be normal thereby excluding brown tumour of hyper-parathyroidism.

Fig. II: Intraoral photograph showing the site of surgery.

In view of the young age of the boy, a conservative surgery was performed under general

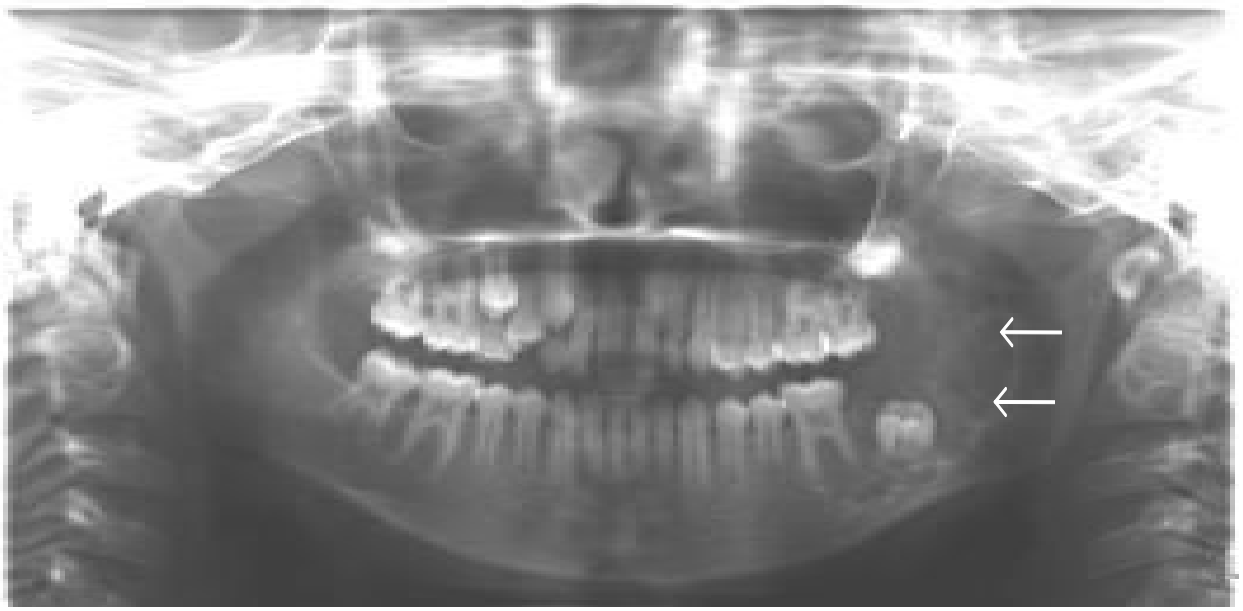

Fig. III: Panoramic radiograph showing multilocular radiolucent lesion with faint curved septae in left ramus-body of mandible.

anesthesia to spare the mandible with an aggressive curettage and marginal resection/peripheral osteotomy of the lesion. The unerupted permanent left mandibular second molar and the first molar were extracted during the procedure. The histopathological examination (Fig. IV) showed a highly vascularized fibrous stroma with several multinucleated giant cells with 20-30 nuclei. Randomly dispersed spindle shaped fibroblasts were also noted and a conclusive diagnosis of a central giant cell granuloma was made. The post surgical follow up (Fig. II & V) has remained uneventful till date.

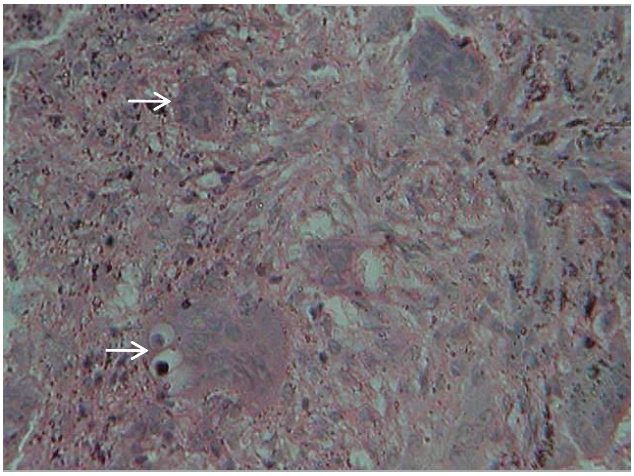

Fig. IV: Photomicrograph (H and E stain, magnification 40 x) showing multinucleated giant cells (~20 nuclei) and spindle shaped fibroblasts in a highly vascularized fibrous stroma.

Discussion:

Giant cell lesions of the jaws generally include cherubism, giant cell granuloma of the jaws, giant cell tumour (GCT), aneurysmal bone cyst, traumatic bone cyst and jaw tumour of hyperparathyroidism. In 1953, Jaffe first described the "giant cell reparative granulomas" and distinguished them from the giant cell tumor that usually is found in the epiphyseal regions of long bones. He established two pathological entities in the jaws, the central giant cell granuloma (CGCG), arising within bone and the peripheral giant cell granuloma (PGCG) arising in soft tissue mass (Jaffe, 1953). Giant cell granuloma was described as an idiopathic non-neoplastic proliferative lesion and termed a reparative granuloma (Jaffe, 1953). Current consensus, however, is that these are not reparative lesions and that if they are not treated, they are progressive. The true nature of the central giant cell granuloma remains speculative. It has been suggested that it may be an inflammatory lesion, a reactive lesion, a true tumor, or an endocrine lesion (Pogrel, 2004). Expression of the c-Src gene has been implicated in the development of CGCG, GCT and cherubism (Wang et al, 2006). In addition, histologically identical lesions occur in patients with known genetic defects such as cherubism, Noonan syndrome, or neurofibromatosis type 1 (deLange et al, 2007). Central giant cell granuloma has been shown in a report to be further associated with a reciprocal translocation t (X; 4) (q22; q31.3) (Buresh et al, 1999).

Central giant cell granuloma is an uncommon lesion, usually asymptomatic and accounting for less than 7 % of all benign jaw lesions (Kramer et al, 1991). The lesion is found predominantly in children and young adults with more than 60% of all cases occurring before the age of 30 years (Kaffe et al, 1996). Lesions occur

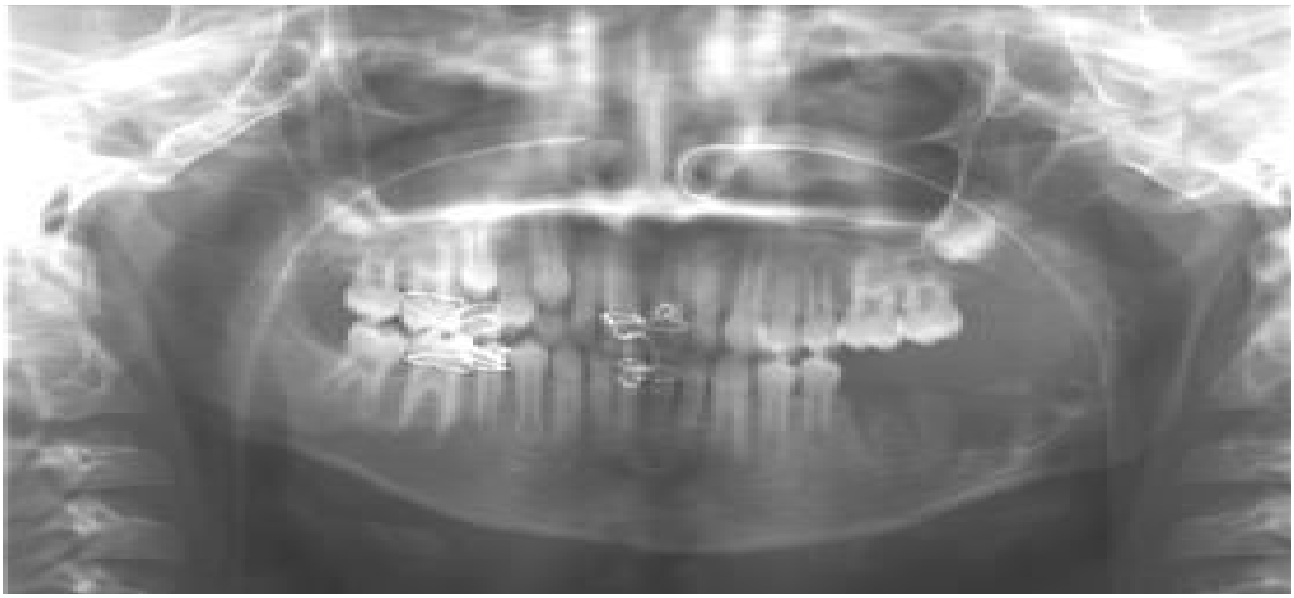

Fig. V: Post operative panoramic radiograph showing extracted tooth no 36 and 37 with area of resection.

more frequently in the mandible than in the maxilla in the anterior region of the jaws (Regezzi & Scuibba, 1989). Radiographically, CGCG presents as radiolucent defect, which may be unilocular or multilocular. The defect usually is well-circumscribed and, in some cases, displacement of teeth can be found (Chuong et al, 1986). Central giant cell granuloma is expansive in its growth; it does not grow around or invade nerve trunks. It also does not invade perineural sheaths or spread via perineural spaces. Histologically, CGCG contain focal arrangements of giant cells within a vascular stroma with thin-walled capillaries adjacent to the giant cells. There is a spindle cell stroma which may well be the cell of origin. The absence of perivascular cuffing (as seen in our case) can help differentiate CGCG from cherubism (Pogrel, 2004). Presence of foreign body type giant cell (as seen in our case and absence of stromal tumour cells differentiate CGCG from a GCT. 'Solid'aneurysmal bone cysts (ABC) are true benign neoplasms containing giant cells while trauma causing intramedullary hemorrhage has been implicated in the past as the etiology. Normal serum calcium, parathyroid hormone, alkaline phosphatase and phosphorous levels distinguish CGCG from other conditions like Brown tumour of hyperparathyroidism (Pogrel, 2004).

Cherubism is a self limiting condition, but giant cell granulomas can be aggressive with a tendency to recur and hence require treatment (Chuong et al, 1986). These lesions should be defined as "aggressive giant cell granulomas" of the jaws, rather than giant cell tumor (Ficarra et al, 1987). Giant cell tumour, on the other hand is aggressive with a high recurrence rate but also has a potential for malignant transformation (Hutter et al 1962). Aggressive/ recurring CGCG have a higher number and relative size index of giant cells and a greater fractional surface area occupied by giant cells (Chuong et al, 1986).

The conservative surgical treatment of CGCG usually involves curettage alone or alongwith peripheral ostectomy with no evidence of disease in a 2 year follow up perior (Eisenbud et al, 1988). The margins of the CGCG may also be thermally sterilized with a laser or cryoprobes (Kermer et al, 1994). Radical surgical techniques of resection without continuity defect and peripheral ostectomy (Bataineh et al, 2002) and enbloc resection have sometimes been justified for aggressive CGCG (Chuong et al, 1986). However, recurrence with serious facial mutilation, loss of teeth and tooth germs seem unavoidable.

Paediatric patients necessitate conservative management to prevent long term developmental defects. Steroids and calcitonin have been advocated in the recent past and they at by inhibition of osteoclastic activity. Equal parts of triamcinolone acetonide (10mg/ml) and 0.5% bupivacaine injected into the lesion for a period of 11 weeks has been shown to be effective in a child patient (Wendt et al, 2009). Relative contraindications do exist in certain medical conditions, such as diabetes mellitus, peptic ulcer,and generalized immunocompromised states. Calcitonin nasal spray 200 U/spray once or twice daily was reported to be safe and effective for the treatment of CGCG (Allon et al, 2009). But, therapy may be complicated owing to the great amount of discomfort and the relatively long duration of treatment, with poor compliance by children. Where surgery has been conservative daily subcutaneous interferon alpha (3 million units/m^2 of body surface area) has been tried as an adjuvant due to its anti-angiogenic properties; but significant side effects may limit its utility (Kaban et al, 2007). A combination of interferon alpha and imatinib given for 9 months has been shown to initiate regression of the lesion that continued after treatment had ceased (de Lange et al, 2009). Bisphosphonates have also been attempted intravenously with promising results (Davis et al, 1991). Nevertheless, recurrences of CGCG are not uncommon and can be seen in upto 46% of cases (Whitaker et al, 1993).

Conclusion:

Giant cell lesions occur frequently in children often showing aggressive behaviour. Our approach to conservatively manage the lesion has shown good results with regular follow up till date. In conclusion, giant cell lesions may present as a diverse group of conditions peculiar to the jaw bones but, their diagnosis and management in the pediatric patient still remains a challenge to the clinician.

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Case Report

Single Rooted Maxillary First Molar: A Rare Case

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Abstract:

Adequate knowledge of the root canal morphology and its variations is essential for successful endodontic treatment. Of all the permanent teeth, maxillary first molar has a wide variety of variations in the root canal morphology. One among the rarest variation is to have a single root with a single canal. This case report presents one such unusual variation in maxillary first molar.

Key Words: Maxillary first molar, single root, canal configuration.

Introduction:

The main objectives of root canal treatment are thorough shaping and cleaning of all the canals and its obturation with an inert filling material. Practitioners must have a thorough knowledge of the internal anatomic relationships of teeth and must be able to visualize these relationships before undertaking endodontic therapy. Together with diagnosis and treatment, knowledge of common root canal morphology and its frequent variations is a basic requirement for endodontic success (Burns & Herbranson, 2002).

Within permanent teeth maxillary first molar has wide variations in its root canal morphology. The literature describes complex root canal systems in maxillary molars that may be difficult to manage. Variations often occur in the mesiobuccal root (Gopikrishna et al, 2008; Kulid & Peters, 1990), the most common finding being the occurrence of two canals. In maxillary first molar cases of morphologic variations, abnormal number of roots or existence of C- shaped canals have been reported previously (De Moor, 2002). Case reports with four and five roots (Christie et al, 1991; Fahid & Taintor, 1998) and four to six root canals (Benenati, 1985; Bond et al, 1988; Jacobsen, 1994; Martinez-Berna & Ruiz Badanelli, 1983) have also been reported.

However, the configuration of one canal in one rooted maxillary first molar has rarely been described in studies either *in-vitro* or *in-vivo* (Gopikrishna et al, 2008). The present case report describes one such rarest variation in maxillary first molar.

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Case Report:

A 22 year old girl with noncontributory medical history was referred to the Department of Conservative Dentistry and Endodontics for evaluation of root canal therapy of a right maxillary first molar. Clinical examination revealed that the tooth responded positively to percussion but not on palpation. Radiographic examination revealed a single root and canal. After adequate anesthesia and isolation with rubber dam, an endodontic access cavity was established. A single orifice with single canal was located. The working length was checked radiographically placing the files in the canal (Fig. I).

Fig. I: Showing intra oral periapical rediograph (IOPA).

The canal was instrumented using crown - down pressure less technique with rotary protaper files and later large sized hand files were used and enlarged upto #120. Irrigation was done with 5.25% sodium hypochlorite. After root canal cleaning and shaping, the canal was dried and filled with Grossmann's sealer and guttapercha. Cavit was used to seal the access. Postoperative radiograph was taken to confirm the quality of the filling (Fig. II). Patient was recalled for permanent restoration and referred to the prosthetic clinic for crown construction.

Fig.II:Showing post obturation intra oral periapical rediograph (IOPA).

Discussion:

Sound knowledge of the root canal morphology and pulp chamber anatomy is a prerequisite for successful root canal treatment. The morphology of the root and canals of the maxillary first molar can be complex and variable. An examination of the floor of the pulp chamber offers clues to the type of canal configuration present. Due to varied morphology, endodontic treatment in a multirooted teeth is a challenging task.

Generally maxillary first molar presents three roots and canals. But deviations are always present. Normally, development of roots begins after enamel and dentin formation has reached the future cementoenamel junction. Prior to root formation the root sheath forms the epithelial diaphragm. The epithelial diaphragm will grow horizontally and convert the wide cervical opening into narrow apical foramen. In multirooted tooth the epithelial diaphragm undergoes differential growth which causes the division of the root trunk into two or three roots. Depending upon the number of divisions, number of roots will be formed. Two divisions will form two roots, three divisions will form three roots and so on (Bhaskar, 2003; Fig.III). The proof is in various documented literatures where maxillary first molar with four or five root canals were shown. In multirooted tooth the epithelial diaphragm is genetically programmed to undergo differential growth but under rarest condition this differential growth may fail to take place. And this may give rise to the formation of single root in maxillary first molar .

Access preparation was made as described in standard literature and the pulp roof was removed. Orifice appeared to be larger than normal. A conventional intra oral periapical radiograph from different angulations was taken placing two files in the canal. Both the files seemed to be in a single canal.

Though we suspected two canals, we ended up in single root and canal. When there is only one

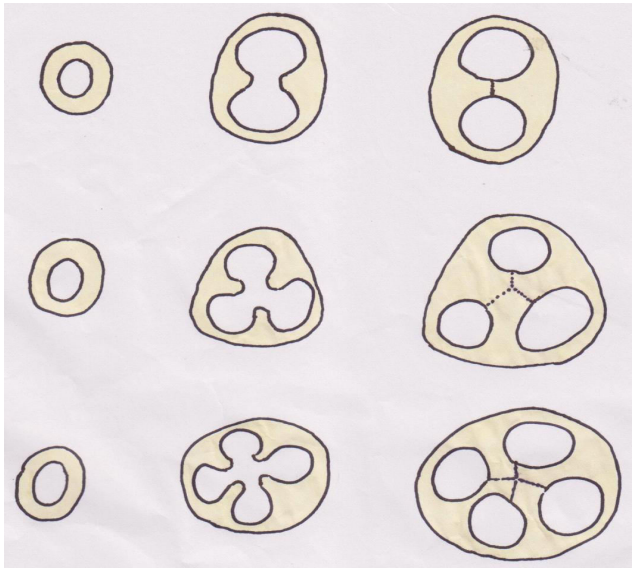

Fig.III: Stages of development of permanent maxillary first molar. Surface view of epithelial diagram.

A. Root formation starts with the formation of epithelial diaphragm.
B. Differential growth of epithelial diaphragm causes the division of root trunk into 2,3,4 roots.
C. Fusion of the horizontal epithelial diaphragm divides single cervical opening into 2,3,4 openings.

canal, it is usually located rather easily in the center of access preparation. A radiograph taken from different angulations revealed unusual variations. Documented literature shows evidence regarding the occurrence of four to six canals. But very few or rather two to three cases have been published regarding single root and canal (Gopikrishna et al, 2008).

To achieve satisfactory root canal therapy, a proper and in-depth knowledge of complex and abnormal root canal morphology is more than essential. The use of multi angled diagnostic radiographs may be very useful in diagnosis of typical cases. Although the incidence of single canal is not high, it is important to take these variations into consideration during root canal treatment of maxillary molar in order to ensure success.

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Informative Article

Pediatric Endodontics- Endodontist's view

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Abstract:

The dental diseases affecting the pulp and periapical tissues in the primary and permanent dentitions pose treatment challenges for the endodontists because of the vast variations in these dentitions basically due to factors like longetivity of primary teeth , coronal structure and root canal morphology and anatomy of the teeth which needs to be critically analysed before rendering treatment. In recent years, new materials, equipments and instruments have evolved to a great extent and simplified the endodontic treatment procedures for the clinicians.

The aim of this article is to highlight the clinical techniques and treatment considerations in treating the vital and non-vital as well as emphasize on surgical management of cases.

Key Words: Pediatric Endodontics, Partial Pulpectomy, pulpotomy.

Introduction:

A number of factors are involved in the development of pulp and periapical disease in primary and permanent teeth, with dental caries being the main factor. Although these factors are similar, the clinical management of a primary or permanent tooth with pulp or periapical disease may be quite different. This is based mainly on the differences between the two types of teeth, with primary tooth longevity, coronal structural integrity, root canal morphology, and root anatomy (Hibbard & Ireland, 1957) being important features to be taken into account when planning the treatment (Table I & II).

The diagnosis of pulp disease is especially difficult in young patients because they are usually unable to give an accurate account of their symptoms. The diagnosis is dependent on the combination of a good history, clinical and radiological examination and special tests. According to Camp (2008), primary teeth with history of spontaneous pain should not receive vital pulpal treatment and are candidate for pulpectomy or extraction. Electric pulp tests and thermal tests are not reliable on primary tooth. Doppler flowmetry might be of great help in determining vitality (Evans et al, 1999). Interpretation of radiographs of primary teeth is always complicated by the presence of the succedaneous tooth and surrounding follicle, resulting into misdiagnosis.

Table I: Anatomic differences between primary and permanent teeth and its significance from pediatric endodontics point of view.

Tooth Anatomic Features	Primary teeth	Permanent teeth	Significance
Overall size	Smaller	larger	---
Pulp chamber	Larger as compared to crown	Smaller as compared. to crown	Ease of access opening
Cervical constriction	Marked constriction	Less constricted in Lateral cervical region	perforation
Root trunk	Short with thin floor of pulp chamber	Large with thicker floor of pulp chamber	Easy furcation involvement.
Root anatomy	Thin, slender (ribbon shaped), flared	Thicker, not flared	Limitation in canal enlargement, Instrument breakage, Perforation
Accessory canals	Present frequently in furcation area and roots	Comparatively less in number	Incomplete pulp extirpation

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The treatment of primary and permanent teeth has changed dramatically in recent years as new

Table II: Histological differences between primary and permanent teeth and its significance

Tooth Anatomic Features	Primary teeth	Permanent teeth	Significance
Apical foramen	Enlarged	Constricted	Abundant blood supply - exaggerated inflammatory response
Pulp function	Formative, Nerve supply, Nutritive, protective, and Resorptive	Formative, Nerve supply, Nutritive, and protective	Degeneration of neural elements-less sensitive to operative procedures
Cellular response to injury	More extensive	Lesser	Incidence of reparative dentin formation is more
Localization of infection and inflammation	Poorer	Better	More chances of spread of infection – space involvement (Cellulitis)
Density of innervation	Less	More	Less sensitive to operative procedures
Pulp nerve fibres	End at the odontoblastic layer	Terminate among the odontoblasts and even beyond the predentin	Less sensitive to pain
Inflammatory response to Calcium hydroxide	Severe	Not demonstrated	Subsequent metaplasia with resultant internal primary root resorption

materials have been developed. Therapy for children has a high rate of success with less post-operative discomfort. Because of the formative state of the pulp, vital procedures heal nicely with good dentin bridging. On the other hand, internal resorption commonly occurs from pulpal inflammation in a primary tooth.

Vital Pulp Therapy:

Indirect pulp capping:-

Indirect pulp treatment is recommended as the most appropriate procedure for treating primary teeth with deep caries and reversible pulp inflammation provided that the tooth has been sealed with a leakage free restoration (Fuks, 2002). There is insufficient evidence to support the use of any one specific lining material for indirect pulp treatment. However, newer research appears to be directed towards the use of glass ionomer cements (Massara et al, 2002). Pulp capping with resin composites in monkeys produced the lowest incidence of bacterial microleakage, pulpal inflammation and incidence of pulpal necrosis when compared with calcium hydroxide and glass ionomer cement (Cox & Suzuki, 1994).

Direct pulp capping-

Direct pulp capping of a carious pulp exposure in a primary tooth is not recommended as treatment failure might result in internal resorption or acute dentoalveolar abscess. In case of inadvertently exposed pulp, free of oral contamination, calcium hydroxide medicament can be used as it maintains the pulp vitality (Fuks, 2005). Presently, direct pulp capping should still be looked on with some reservations in primary teeth. Caicedo et al (2006) demonstrated good pulp response in primary teeth after direct pulp capping or pulpotomy with MTA (Mineral Trioxide Aggregate) and concluded that MTA might be a favourable material for pulp capping and pulpotomy in primary teeth.

Pulpotomy:

Pulpotomy and partial pulpectomy techniques for devitalized primary teeth have been developed to preclude an almost impossible obturation problem. Pulpotomy is still the most common treatment for cariously exposed pulp in symptom free primary molars. Formocresol has been a popular pulpotomy medicament in the primary dentition for the past 70 years since it is introduction by Sweet in 1932 (Vij et al, 2004). Nevertheless several studies have reported that the clinical success of FC pulpotomies decreases with time, and the histologic response of the primary pulp is "capricious" ranging from chronic inflammation to necrosis (Rolling & Thylstrup, 1975). Presently, there are several pulp dressing medicaments that have been proposed that are equal to if not better than, Formocresol and can be used as alternatives to pulpotomies in primary teeth. These include: electrosurgery (Fishman et al, 1996), laser (Elliot et al, 1999), glutaraldehyde (Araujo et al, 1995), calcium hydroxide (Huth et al, 2005), freeze dried bone (Fadavi & Anderson, 1996),

bone-morphogenic protein (Nakashima, 1994), osteogenic protein (Rutherford et al, 1993), ferric sulfate (Ibricevic & al-Jame, 2000), mineral trioxide aggregate (MTA) (Fuks, 2008) and sodium hypochlorite (Vargas et al, 2006).

Non-Vital Pulptherapy:

Pulpectomy-

Non-vital primary teeth may be retained successfully when pulpectomy procedure is employed. A single visit or two- visit pulpectomy may be undertaken. Primary molar roots are severely curved and the pulps are flat and tortuous with numerous branches and interconnections. This necessitates modifications in biomechanical procedures. The root canals are cleaned and shaped and subsequently filled with resorbable paste (Zinc oxide eugenol, or calcium hydroxide or iodoform base). Recently investigators have found that Vitapex (a mixture of calcium hydroxide and iodoform) has superior success rate to that of traditionally used zinc oxide eugenol (100% versus 78.5% at 16 months) and is removed more readily if extruded through an apex (Mortazavi & Mesbahi, 2004).

Treatment Modalities for Young Permanent Teeth:

Apexification and apexogenesis-

When providing treatment for patients with mixed and young permanent dentitions, certain clinical scenarios may require interdisciplinary consultation and intervention such as following traumatic injuries and whenever permanent teeth require endodontic therapy.Young pulps in immature permanent teeth are larger than at a more mature stage. Immature permanent teeth have funnel shaped apical foramina which are commonly called "blunderbuss". Walls of root canal are very thin in newly erupted immature teeth which are further weakened during the cleaning and shaping procedures (Fig. I). The relatively thin dentin walls of the large obturated canals place the tooth at greater risk for root fracture over time. In these instances, the treatment objective is to maximize the opportunity for apical development and closure, known as apexogenesis or apexification, and enhance continued root dentin formation. Figure 1 shows a case of non-vital 45 with open apices of an old female child who reported to clinics with a complaint of decayed teeth. In the following case root canal was cleaned and calcium hydroxide was placed within 1-2mm of root apex to encourage either root growth or apical repair (Fig. II). Recent studies suggest 3 monthly change of Calcium hydroxide (Mackie, 1998). Hence Calcium hydroxide dressing was changed every 3 months and radiographic follow up was done at 1,3,6,9 months. After the barrier was evident radiographically (Fig. III) and clinically, the tooth was reisolated and opened for final obturation of canal with gutta-percha (Fig. IV).

Fig. I: A Case of Non- vital 45 with open apices.

Fig. II: Apexification with Calcium hydroxide.

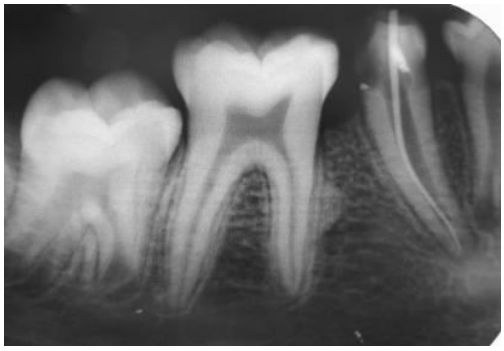

Fig.III: Radiographically and clinically evident calcific barrier.

The current data available on the use of MTA in vital pulp therapy indicate that it is the optimum material and better than the traditionally used material calcium hydroxide. It has a better long term sealing ability and stimulates a high quality and a greater amount of reparative dentin and has also demonstrated a high success rate (Witherspoon, 2008).

Fig. IV: Post Operative radiograph (12 months follow up).

If attempts to induce root end closure are unsuccessful with persistent sinus tract, it calls for surgical intervention. With mutual consent of parents the procedure can be carried out under sedation or general anesthesia. Root canal filling procedure is completed prior to surgical opening and removal of apical filling, followed by root end closure with MTA.

Recent Advances:

Pulp revascularization and Stem cell research holds great hope for the future and can be considered as novel treatment modalities for the management of primary and young permanent teeth (Banchs & Trope, 2004).

Conclusion:

A successful pediatric endodontic outcome should be based on (1) re-establishment of healthy periodontal tissues; (2) freedom from pathologic root resorption; (3) maintenance of the primary tooth in an infection-free state to hold space for the eruption of its permanent successor; (4) in the case of young permanent teeth, maintenance of the maximum amount of noninflamed portions of pulp tissue to enhance apexogenesis and root dentin formation. With adherence to sound principles in case selection and techniques, pediatric pulp therapy is a major health benefit to the child. The treatment modalities and medicaments that have been discussed, highlighting the most substantiated and qualifying those that need sfurther confirmation by additional research. The clinician must realize that these recommendations are not absolute and will continue to be modified.

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Review Article

Tissue Engineering : Is it the future of Endodontics?

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Abstract:

Pulpal regeneration after tooth injury is not easy to accomplish, because of the infected pulp requires tooth extraction or root canal therapy. Current treatment modalities offer high levels of success for many conditions; an ideal form of therapy might consist of regenerative approaches in which diseased or necrotic pulp tissues are removed and replaced with healthy pulp tissue to revitalize teeth.

This review describes the possible techniques that will allow regenerative endodontics to become a reality. These potential approaches include root canal revascularization, postnatal stem cell therapy, pulp implant, scaffolding implant, three dimensional cell printing, injectable scaffolds and gene therapy.

Key Words: Tissue engineering, Regenerative endodontics, Pulp revascularization, Dental pulp stem cells, Morphogens, Scaffolds.

Introduction:

There is a high rate of success in retention of teeth by endodontic therapy. However, many teeth are not restorable because of apical resorption, fracture, incompletely formed roots or carious destruction of coronal structures. A novel approach to restore tooth structure is based on biology ie, regenerative endodontic procedures by the application of tissue engineering.

Tissue engineering is an emerging multi disciplinary field that applies the principles of engineering and life sciences for the development of biological substitutes that can restore, maintain, or improve tissue function (Langer & Vacnati, 1993).

Regenerative endodontic procedures can be defined as biologically based procedures, designed to predictably replace damaged, diseased, or missing structures, including dentin and root structures as well as cells of the pulp dentin complex with live viable tissues preferably of the same origin that restore the normal physiologic functions of the pulp dentin complex (Murray et al, 2007).

Hermann (1952) was the first to carry out regenerative endodontic procedure, when he applied calcium hydroxide in vital pulp amputation. Subsequent regenerative dental procedures included guided tissue or guided bone regeneration (GTR, GBR) procedures and distraction osteogenesis (Block et al, 1995), the application of platelet rich plasma (PRP) for bone augmentation (Kassolis et al, 2000), emdogain for periodontal tissue regeneration (Heijl et al, 1997), recombinant human bone morphogenic protein (rhBMP) for bone augmentation (Fjuimura et al, 1995), and preclinical trails on the use of fibroblast growth factor 2 (FGF2) for periodontal tissue regeneration (Takayama et al, 2001; Lin et al, 2010).

A counter argument to the development of regenerative endodontic procedure is that although the replaced pulp has potential to revitalize the teeth, it may also become susceptible to further pulp disease and may require retreatment.

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Regenerative endodontics comprises of research in:

1. Adult stem cells
2. Growth factors
3. Organ tissue culture
4. Tissue engineering materials

Adult stem cells:

All tissues originate from stem cells. A stem cell is defined as a cell that has the ability to continuously divide to either replicate itself (self replication) or produce specialized cells that can differentiate into various other types of cells or tissues (Rao, 2000). Types of stem cells are:

1. Early embryonic stem cells
2. Blastocyst embryonic stem cells
3. Fetal stem cells
4. Umbilical cord stem cells
5. Adult or postnatal stem cells

The plasticity of stem cell defines its ability to produce cells of different tissues. Stem cells are commonly subdivided into totipotent, pluripotent and multipotent categories according to their plasticity.

To accomplish endodonitc regeneration, the most promising cells are autologous postnatal stem cells, because these appear to have the minimum disadvantages. Postnatal stem cells have been found in almost all body tissues, including dental tissues. Four types of human dental stem cells have been isolated:

(a). Dental pulp stem cells (DPSCs; Gronthos et al, 2000)
(b). Stem cells from Human exfoliated deciduous teeth (SCHED; Miura et al, 2003)
(c). Stem cells from apical papillae (SCAP; Sonoyama et al, 2006)
(d). Periodontal ligament stem cells (PDLSCs; Seo et al, 2004)

Odontoblasts are postmitotic terminally differentiated cells which cannot proliferate to replace subjacent irreversibly injured odontoblasts. The ability of both young and old teeth to respond to injury by induction of reparative dentinogenesis suggests that a small population of competent progenitor pulp stem cells may exist within the dental pulp throughout life. Information on the mechanism by which these cells are able to detect and respond to tooth injury is a scarce, but this information will be valuable for use in developing tissue engineering and regenerative endodontic therapies.

Stem cell lines are usually grown in medium containing animal products. Fetal bovine serum is an important additive for cell growth, however, the allergenic potential and the possibility of contamination while using a medium containing serum would be a barrier to transplantation and consequently to the introduction of cell therapy methods into clinical applications.

Studies have shown that serum free growth medium consisting of Dulbecco modified Eagle medium with antibiotic and antimycotics which was supplemented with 1 % Insulin-Transferring-Selenium-X and 100 μg/ ml of embryotropic factor showed an acceptable survival rate, the highest proliferation rate and the strongest expression of all the stem cell markers. It also proved to be a suitable medium for the culture of human dental pulp stem cells and to preserve pluripotent in differentiation (Hirata et al, 2010).

The regeneration of dental tissue relies on the ability of stem cells to produce extracellular matrix proteins encountered in the dental pulp tissue.

The distribution and expression of extracellular matrix proteins differ among the DPSCs. These differences seem to be related to the donor tooth condition like deciduous or permanent, retained or erupted and degree of root resorption (Harumi Miyagi et al, 2010).

However, it is not yet clear which type of stem cell source are most potent and best for targeted therapy. Lack of understanding of nature of these cells and their lineage specific propensity might hinder their full potential. Studies have demonstrated that gene variations occurre within the different sources of the same cells and these variations determine their lineage propensity towards specific destination. Stem Cells of Deciduous teeth retained their plasticity over the passages, where as Permanent Stem Cells lost their plasticity and were shown to be more committed towards neuronal lineage (Govindasamy et al, 2010). It seems evident that the dental pulp might be used only as a source of progenitor cells with dentinogenic competence for the regeneration of dentin pulp complex.

The differentiation potential of apical papilla progenitor cells has not been established yet. The nature of all embryonic dental papilla, mature dental pulp and apical papilla progenitor cell populations remain to be characterized further (Tziafas & Kodonas, 2010).

Recent evidence suggests that stem cells are localized in areas with low oxygen tension. Work on hemotopoietic and neural stem cells showed that culturing progenitors in hypoxic conditions increases the number of multipotent clones when compared with normoxic cultures. In addition to effects on differentiation and cell fate, hypoxia promotes survival and increases the proliferation of multipotent precursors. This phenomenon may depict clinical situations in which pulp tissues are affected by noxious stimuli such as mechanical pulp exposure or trauma that leads to localized ischemia. The secondary dentin bridge that formed under the injury site is possibly the product of differentiated progenitors from deciduous pulp stem cell reservoir. Further studies are required to understand whether DPSCs react differently to signaling molecules after hypoxic treatment, which might alter their differentiation potential (Sakdee et al, 2009).

Growth factors:

Growth factors are proteins that bind to receptors on the cell and induce cellular proliferation or differentiations. Many growth factors are quite versatile, stimulating cellular division in numerous cell types, while others are more cell specific. Bone morphogenic proteins (BMPs) are important growth

factors required in tooth development and regeneration. Recombinant BMP-2,-4,-7 induce formation of reparative dentin *in vivo* (Nakashima, 1994).

The application of recombinant human insulin like growth factor-1 together with collagen has been found to induce complete dentin bridging and tubular dentin formation (Lovschall et al, 2001). This indicates the potential of adding growth factors before pulp capping or incorporating them into restorative and endodontic materials to stimulate dentin and pulp regeneration. The therapeutic effect of calcium hydroxide may be because of its extraction of growth factors from dentin matrix (Smith et al, 1995). Once released, these growth factors may play key roles in signaling many of the events of tertiary dentinogenesis, a response of pulp dentin repair.

Data suggest that FGF2 plays a role not only as a differentiation inducing factor in the injury repair process of pulpal tissue but also as a positive regulator of chemokine expression, which may help in tissue engineering and pulp regeneration using Human DPSCs. However, the fate of odotoblastic or osteoblastic differentiation, effective local delivery for FGF2 interaction of chemotactic and odotogenic factor limitations need to be overcome (Kim et al, 2010).

Ability of MTA to induce useful cellular response to achieve suitable tissue wound healing is by promoting by adhesion, supporting cellular proliferation and by inducing migration of human mesenchymal stem cells.

Mesenchymal stem cells are usually involved in tissue and bone remodeling, and local environment is thought to play an important role in the commitment and differentiation of mesenchymal derived stem cells (D'Anto et al, 2010).

Scaffold:

The scaffold provides a physico-chemical and biological three dimensional micro environment for cell growth and differentiation, promoting cell adhesion and migration. The scaffold serves as a carrier for morphogen in protein therapy and for cells in cell therapy.

Types of scaffolds:

(a). Biological or Natural eg. Collagen, Glycosamino-glycan

(b). Artificial or Synthetic eg. Poly lactic acid (PLA) Poly glycolic acid (PGA), Poly ethylene glycol (PEG), Arginine, Hydroxyapatite, Tricalcium Phoshate

Gene therapy:

New techniques involving viral or non viral vectors that can deliver genes for growth factors, morphogens, transcription factors and extracellular matrix molecules into target cell populations has been developed.

The use of gene delivery in endodontics would be to deliver mineralizing genes into pulp tissues to promote tissue mineralization. Dr.Rutherford transfected ferret pulps with cDNA-transfected mouse BMP-7 that failed to produce a reparative response, suggesting that further research is needed to optimize the potential of pulp gene therapy (Rutherford, 2001).

Because of the apparent high risk of health hazards, the development of a gene therapy to accomplish endodontic treatment seems very unlikely in the near future.

Potential technologies for regenerative endodontics:

Following are the areas of research that might have application in the development of regenerative endodontic techniques:

1. Root canal revascularization via blood clotting
2. Postnatal stem cell therapy
3. Pulp implantation
4. Scaffold implantation
5. Injectable scaffold delivery
6. Three – Dimensional cell printing
7. Gene therapy

A study has found that inducing bleeding of pulp was easier and effective when an anesthetic solution did not contain a vaso constrictor (Petrino et al, 2010).

Research priorities for developing regenerative endodontic techniques:

(a). Improved methods to disinfect and shape root canal systems:-

The majority of the available evidence suggests that necrotic and infected tooth pulp does not heal. It will be necessary to disinfect the root canal systems and remove infected hard and soft tissues before using regenerative endodontic treatments.

To successfully attach and adhere to root canal dentin, the stem cells must be supported within a polymer or hydrogel scaffold. Furthermore, it has been observed that pulp stem cells, periodontal stem cells, and fibroblasts neither adhere nor grow in infected root canal system. Chlorhexidine gluconate has been studied for its various properties like antimicrobial activity and

biocompatibility, with the objective of evaluating it as an alternative to sodium hypochlorite (Trojani et al, 2005).

(b). Smear layer removal:-

The presence of a smear layer on root canal walls may inhibit the adherence of implanted pulp stem cells, potentially causing the regenerative endodontic treatment to fail. Improved methods to remove the smear layer from the root canal walls appear to be necessary to help promote the success of regenerative endodontics.

Recently MTAD, which is an aqueous solution of 3% doxycycline, 4.25% citric acid and 0.5% polysorbate detergent, has been studied for its biocompatibility, broad spectrum antibacterial activity and effective removal of endodontic smear layer.

Table I: Developmental approaches for regenerative endodontic techniques

TECHNIQUE	ADVANTAGES	DISADVANTAGES
Stem Cell Therapy (Rao, 2000) Autologous or allogenic stem cells are delivered to teeth via injectable matrix	• Quick • Easy delivery • Least painful • Cells are easy to harvest	• Low cell survival • Cells do not produce new functioning pulp • High risk of complications
Growth Factors (Kim et al, 2010) FGF2, BMPs	• Helps in differentiation • Modulates repair process in pulp tissues	• Interaction of chemotactic and odontogenic factor limitations need to be over come
Pulp Implan (Helminger et al, 1997) Pulp tissue is grown in the laboratory in sheets and implanted surgically	• Sheets of cells are easy to grow • More stable than an injection of dissociated cells	• Sheets lack vascularity so only small constructs are possible • Must be engineered to fit root canal precisely
Scaffold implant (Nakashima, 2005) Pulp cells are seeded onto a 3-D scaffold made of polymers and surgically implanted	• Structure supports cell organization • Some materials may promote vascularization	• Low cell survival after implantation • Must be engineered to fit root canal precisely
3-D cell printing (Baron et al, 2005) Inkjet like device dispenses layers of cells in a hydorgel which is surgically implanted	• Multiple cell types can be precisely positioned	• Must be engineered to fit root canal precisely • Early stage research has yet to prove functional *in- vivo*
Injectable scaffolds (Trojani et al, 2005) Polymerizable hydrogels, alone or containing cell suspension are delivered by injection	• Easy delivery • May promote regeneration by providing substitute for extracellular matrix	• Limited control over tissue formation • Low cell survival
Bioactive materials (D'Anto et al, 2010) Mineral trioxide aggrigate	• Promotes cellular adhesion • Supports cellular proliferation • Induces migration of human mesenchymal cells	• Reaction with other local factors are unknown
Gene therapy (Rutherford, 2001) Mineralizing genes are transfected into the vital pulp cells of necrotic and symptomatic teeth	• May avoid cleaning and shaping root canals • May avoid the need to implant stem cells	• Most cells in a necrotic tooth are already dead • Difficult to control • Risk of health hazards
Coenzymes (Okamoto et al, 2009) 3-hydroxy-3-methyl glutaryl coenzyme A	• Known to induce anigogenisis • Increases neurogenesis • Anti inflammatory effect	• Cell death observed with high concentration
Root canal Revasculization (Banchus, & Trope, 2004) open up tooth apex to 1mm to allow bleeding into root canals	• Lowest risk of immune rejection • Lowest risk of pathogen transmission	• Potential risk of necrosis if tissue becomes re infected

However, its interaction with regenerating pulpal tissue is unknown.

(c). Delivery of regenerative endodontic procedures:-

The cells may then be seeded in the apical 1 to 3 mm of a tissue engineered scaffold with the remaining coronal 15+ mm containing an acellular scaffold that supports cell growth and vascularization. This tissue construct may involve an injectable slurry of {hydrogel+ cells + X (growth factors); Torbinejad et al, 2003}.

Studies have shown that clinically compromised dental pulp might contain putative cells with certain stem cell properties. Further characterization of these cells will provide insight regarding whether they could serve as a source of endogenous multipotent cells in tissue regeneration based dental pulp therapy (Wang et al, 2010).

Challenges and future direction:

Despite the impressive progress in tissue engineering approaches to regenerative pulp therapy, numerous challenges remain. The associated broad spectrum of responses in pulp includes neural and vascular regeneration.

(a) Nerve regeneration:

Dental pulp is richly innervated. The main nerve supply enters the pulp through apical foramen along with the vascular elements. They include both sensory and sympathetic nerves. Pulpal nerves play a key role in regulation of blood flow, dentinal fluid flow, and pressure. The innervation of the pulp has a critical role in the homeostasis of the dental pulp. The pulpal nerve fibers contribute to angiogenesis, extravasation of immune cells and regulate inflammation to minimize initial damage, maintain pulp tissue, and strengthen pulpal defense mechanisms. The increasing interest in tissue engineering of tooth must take into account neuro-pulpal interactions and nerve regeneration (Nosrat et al, 2004).

(b) Vascular regeneration:

Pulp vasculature plays an important role in regulating inflammation and subsequent repair and regeneration of dentin. There is an intimate association of the neural elements with vascular supply of the dental pulp suggesting the interplay of neural and vascular elements and involvement in pulp homeostasis. The vascular endothelial growth factor (VEGF) is an excellent regulator of angiogenesis and is known to increase vascular permeability. VEGF induces chemotaxis, proliferation and differentiation of human dental pulp cells. The utility of gene therapy in stimulation of vascular growth permits local stimulation of vascularization during regeneration (Matsushita et al, 2000).

The recent advances in vascular biology and VEGF and techniques of gene transfer and gene therapy will be of potential clinical utility in dentistry, specially in endodontics.

Statin, 3-hydroxy-3-methy glutayl coenzyme A reductase inhibitor, is known to promote bone formation. Pulp tissue contains a large amount of blood vessels and peripheral nerves. Statin is known to induce angiogenesis and to regulate the survival and increase neurogenesis of neuronal cells, indicating the possible effectiveness of statin in pulp regeneration along with dentin regeneration. Furthermore, statin has an anti-inflamatory effect in various tissues. This could help to restore the inflamed pulp tissue. Taken together, results suggest that statin might be an ideal active ingredient in pulp capping material to accelerate reparative dentin formation. However, at the same time attention has to be paid to the cell death observed in the cells treated with high concentration of statin. Therefore, a careful evaluation of the suitable concentration is required before its use in pulp regeneration (Okamoto et al, 2009).

(c) To measur appropriate clinical outcomes we have to find out the following:

- Vascular blood flow
- Mineralizing odontoblstoid cells
- Intact afferent innervations
- Lack of signs or symptoms

Conclusion:

Tissue engineering using the triad of dental pulp stem cells, morphogens and scaffolds may provide an innovative and biologically based approach for generation of clinical materials and treatment of dental diseases.

The challenges of introducing endodontic tissue engineered therapies are substantial; the potential benefits to patients and the profession are ground breaking.

Better understanding of cell interactions and growth along with further research can make endodontic tissue engineering a reality in the near future.

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